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October 10, 1991

Ms. Marcia Bailey
U.S. Environmental Protection Agency Region 10
1200 Sixth Avenue
Seattle, WA 98101

Subject: Contract No. 68-W9-0009, Work Assignment No. 12R10047
Operation and Maintenance Inspection
Yakima Agricultural Research Laboratory, Washington

Dear Ms. Bailey:

PRC Environmental Management, Inc. (PRC) is pleased to submit one copy of the Operation and Maintenance Inspection Report for the Yakima Agricultural Research Laboratory (YARL). Also, analytical data from the YARL inspection has been entered into the RCRA Groundwater Database as required by the Regional Groundwater Management Order (R107500.1). Enclosed is a computer disk and a hard copy of the data. Please forward the database information to Matt Gubitosa.

If you have any questions or comments, please contact Ben Farrell or me at 624-2692.

Sincerely,

Gary A. Bruno
Environmental Geologist

Enclosures

cc: Vicky Tapang, EPA Region 10 (without enclosures)

3.2

U.S. Environmental Protection Agency
Office of Waste Programs Enforcement
Contract No. 68-W9-0009

YAKIMA AGRICULTURAL
RESEARCH LABORATORY

YAKIMA, WASHINGTON

OPERATION AND MAINTENANCE
INSPECTION REPORT

TES 12

Technical Enforcement Support at Hazardous Waste Sites Zone IV Regions 8, 9, and 10

prc
PRC Environmental Management, Inc.

draft

YAKIMA AGRICULTURAL RESEARCH LABORATORY

YAKIMA, WASHINGTON

OPERATION AND MAINTENANCE INSPECTION REPORT

Prepared For

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Waste Programs Enforcement
Washington, D.C. 20460

Work Assignment No.	:	12R10047
EPA Region	:	10
EPA ID. No.	:	WAD 120513957
Date Prepared	:	October 10, 1991
Contract No.	:	68-W9-0009
Work Assignment No.	:	212-R1004709
Prepared by	:	PRC Environmental Management, Inc. (Benjamin R. Farrell)
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EXECUTIVE SUMMARY

PRC Environmental Management, Inc. (PRC), received Work Assignment No. 112R10047 from the U.S. Environmental Protection Agency (EPA) to conduct an operation and maintenance (O&M) inspection at the Yakima Agricultural Research Laboratory (YARL) in Yakima, Washington. At the request of EPA, PRC performed the O&M inspection to evaluate how the facility operates and maintains its groundwater monitoring system in terms of pertinent RCRA regulations and permit requirements.

PRC assessed the maintenance and above ground construction of the monitoring wells and the sampling methods used by the facility contractor. In general, the monitoring well maintenance and construction, and sampling procedures used by the facility contractor are adequate to ensure the collection of representative groundwater samples. In accordance with 40 CFR 265.92, the sampling and analysis plan (Hong West and Associates 1990a) provides adequate procedures and techniques for groundwater sample collection, sample preservation and shipment, analytical procedures, and chain-of-custody control.

PRC makes the following recommendations regarding field sampling procedures observed during the site visit:

- The pump rate observed during the collection of volatile organic compounds was commonly too high. The facility contractor should reduce the pump rate to minimize the potential for sample volatilization.
- The teflon tubing connected to the pump discharge outlet was too short at monitoring well MW-D. Because of this situation, potentially contaminated groundwater was spilled on the ground surface, and the lip of sample containers was allowed to contact the teflon tubing. A longer length of tubing should be installed.
- Purge water collected in drums should be covered until chemical analysis has been completed.
- The facility contractor should have extra glassware available during sampling.
- Total well depth was not measured during the sampling event. The sampling and analysis plan states that total well depth would be monitored on a monthly basis. In accordance with EPA (1986a), total well depth should be measured regularly in order to monitor the wells for siltation problems and well integrity.

The facility contractor found no pesticide or volatile organic contamination during the May 6, 1991 Round 9 of groundwater sampling. Metals such as calcium, sodium, magnesium, and potassium were detected by the facility contractor in relatively high concentrations in both upgradient and downgradient wells. These relatively high background concentrations

could be related to local agricultural practices. A concentration of 3.5 micrograms per liter (μg/L) lead was detected in one of the downgradient monitoring wells, MW-A.

Results from split samples collected by PRC show low concentrations of lead and arsenic in groundwater samples from both upgradient and downgradient wells at the YARL site. The arsenic was detected in concentrations below the quantitation limits of the facility laboratory. Concentrations of metals such calcium, sodium, magnesium, and potassium were detected at concentrations comparable to those reported by the facility contractor. No significant differences were found between dissolved and total metals analysis in the split samples collected by PRC, indicating that most of the metals are dissolved in the groundwater. Split sample results also show low concentrations of chloroform and endosulfan sulfate in all of the downgradient monitoring wells, but not in upgradient monitoring well MW-D. However, both of the contaminants were found in concentrations below the quantitation limit of the facility laboratory.

The good comparability between split sample data and the facility analytical data suggests that the facility analytical program is adequate. The detection of contaminants below the facility laboratory quantitation limits by the EPA approved laboratories shows the potential for very low levels of groundwater contamination to exist and not be detected by the facility laboratory.

The EPA approved closure plan states that the facility will completely characterize the YARL site hydrogeology and assess the interconnection of the upper and lower aquifers at the site. PRC notes the following deficiencies regarding the YARL hydrogeologic site characterization:

- Anomalous water level measurements at monitoring well MW-B should be explained rather than disregarded.
- The cause for the monthly variations in the direction of groundwater flow should be investigated. The facility should evaluate the seasonal use of nearby irrigation wells and ditches to determine whether irrigation practices are affecting groundwater flow directions at the site.
- The degree of interconnection between the upper alluvial aquifer and underlying aquifers has not been established. At a minimum, the facility should define and more completely characterize the underlying aquifers through examination of well logs or permits for local water supply wells and discussion with parties involved in local groundwater monitoring or supply of groundwater.

1.0 INTRODUCTION

This report describes the operation and maintenance (O&M) inspection conducted on May 6, 1991 at the Yakima Agricultural Research Laboratory (YARL) site in Yakima, Washington. The specific objectives of the YARL O&M inspection were to:

- Evaluate the compliance of the groundwater monitoring system with the Resource Conservation Recovery Act (RCRA) interim status groundwater monitoring regulations (40 CFR 265 Subpart F) and protocols specified in EPA (1986)
- Determine whether sampling devices are in working order and are properly maintained
- Evaluate the facility sampling and analysis plan
- Determine whether individual monitoring wells yield representative groundwater data
- Evaluate groundwater contamination from analytical results of split groundwater samples received by PRC
- Evaluate the analytical program of the facility through the comparison of facility and split sample analytical results

PRC personnel present onsite were Ben Farrell, geologist, and Julie Howe, environmental scientist. Technical points were discussed with Sweet-Edwards/EMCON, Inc. geologist Becky Hylland. A photographic log of the site visit is shown in Appendix A.

2.0 SETTING AND SITE HISTORY

The YARL site is a RCRA-regulated land disposal facility located at 3706 West Nob Hill Boulevard in Yakima, Washington. The 9.5 acre site is situated in a residential area as shown in Figure 1. Three schools, two hospitals, and three shopping centers are located within one-half mile of the site (Tetra Tech 1989). The objective of this inspection was to evaluate the groundwater monitoring system associated with a septic tank/drainfield system.

The laboratory is administered by the U.S. Department of Agriculture. Originally an orchard, the YARL site began to be used for pesticide research in 1961. Several types of pesticide wastes and solvents were disposed of directly on the ground until 1965. Between 1965 and 1985, wastes were discharged to a septic tank and drainfield via a sink and/or a concrete pad at the facility (Tetra Tech 1989).

The septic system, which is in the process of removal as part of the facility closure effort, consisted of a 300-gallon concrete tank connected to a 4-inch diameter, 30-foot long drain tile. The drain tile sloped to the southeast and was installed between 2 and 4 feet below ground surface (bgs). Overflow effluent from the tank was discharged through the drain tile. Beginning in approximately 1965, pesticide-contaminated laboratory equipment was rinsed in a sink in the pesticide storage building, and the rinse water drained from the sink into the septic tank.

In approximately 1974, a 165-foot square concrete pad was installed for the purpose of cleaning pesticide application and miscellaneous farm equipment. A surface drain was constructed along the perimeter of the concrete pad. This surface drain was connected to the septic tank with a 4-inch concrete pipe. Field sprayers, tractors, and other equipment were rinsed on this pad.

Disposal of pesticide products via the lab sink stopped by 1984 and the surface drain surrounding the concrete wash pad was sealed in June 1985. Roughly 5,000 gallons of rinsate from pesticide application equipment and a maximum of 250 gallons of various solvents and pesticide solutions were discharged through the system yearly (Biospherics 1988). The presence of highly permeable sands and gravels caused concern that pesticides and solvents had leached into the shallow drinking water aquifer (Tetra Tech 1989).

YARL submitted a RCRA Part A permit application in September 1980. A preliminary assessment and site investigation pursuant to the Comprehensive Environmental Response, Conservation, and Liability Act (CERCLA) was conducted in June 1982. The site was proposed for the Superfund National Priority List in December 1982. YARL is currently ranked 1026 among the 1073 sites on the National Priorities List (56 Federal Register 5605, February 1991).

A closure plan for the septic tank and drainfield system that includes a monitoring plan for sampling and analyzing groundwater and soils was submitted by YARL in January 1985. In March 1987, YARL submitted a revised version of this closure plan, which was approved by Washington Department of Ecology in May 1987. However, in September 1987, EPA determined that the closure plan did not meet the requirements of 40 CFR 265 Subpart G and requested that a revised closure plan be submitted to EPA after implementation of a groundwater monitoring system pursuant to 40 CFR 265 Subpart F. This groundwater monitoring system, consisting of four wells, was installed in April 1988. A revised closure plan was submitted and subsequently approved by EPA on January 30, 1990. The central component of the EPA-approved plan is to achieve clean closure under 40 CFR 265 subpart G. As required by the approved closure plan, three additional monitoring wells were drilled and completed by July 1990. The purpose of the three additional wells was to determine the vertical hydraulic gradient at one locality, and to

provide a more complete monitoring network, which was deemed necessary due to the variation in groundwater flow directions at the site (Tetra Tech 1989).

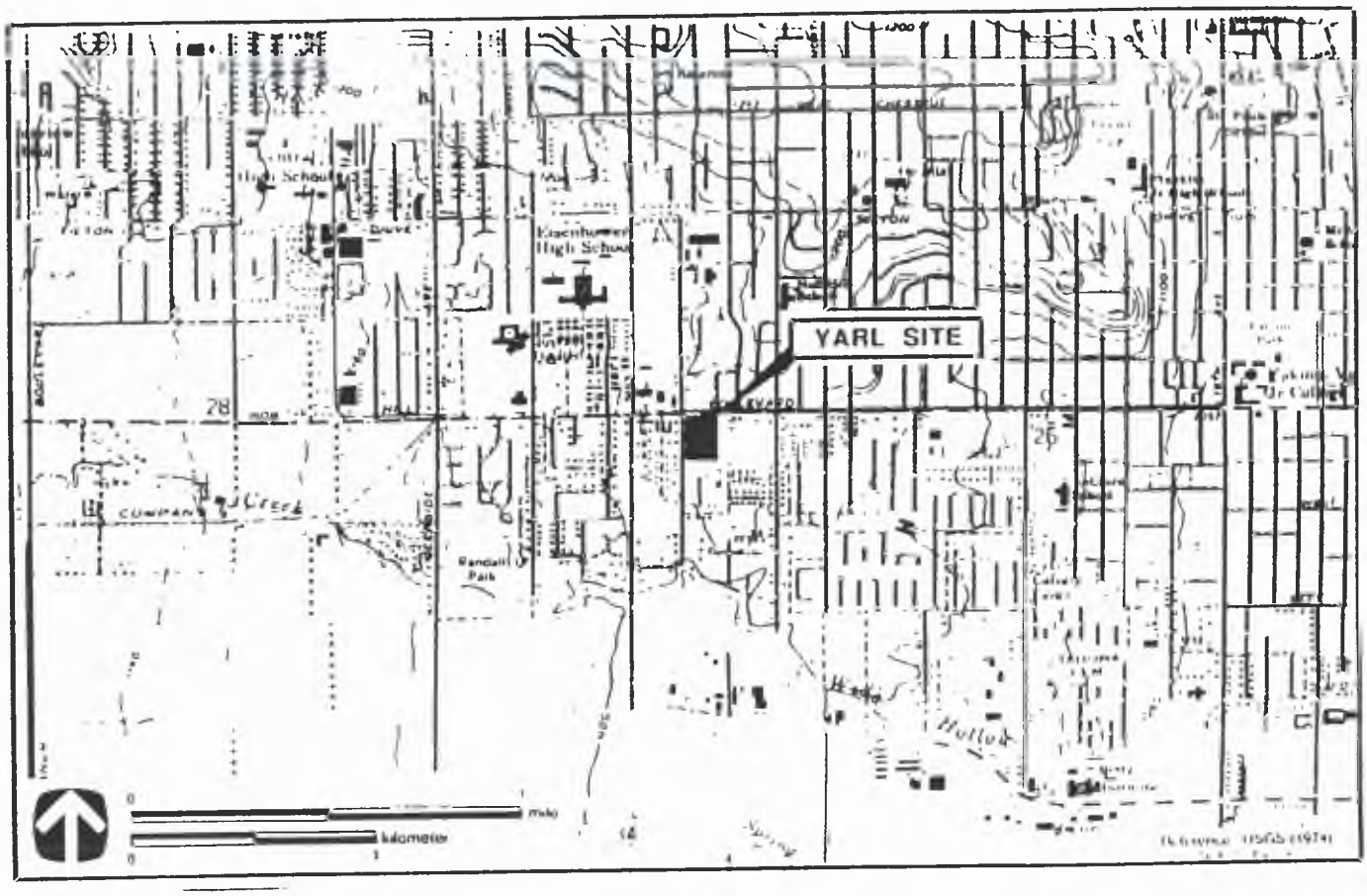
3.0 SITE GEOLOGY AND HYDROGEOLOGY

There are two main aquifers of concern underlying the YARL site. The shallow aquifer consists of alluvial sands and gravels of the Ellensburg Formation. The deeper aquifer is located in interflow zones of the underlying Columbia River basalts (Tetra Tech 1989). The total thickness of the Ellensburg Formation at YARL has not been determined. Basalt bedrock was not encountered at a maximum drilling depth of 125 feet. The water table at the site is located 34 to 38 feet bgs. The direction of groundwater flow in the upper aquifer is generally to the south-southeast toward Wide Hollow Creek (Tetra Tech 1989). The direction of groundwater flow in the upper aquifer may vary by as much as 45 degrees between consecutive months (Tetra Tech 1989).

4.0 GROUNDWATER MONITORING SYSTEM

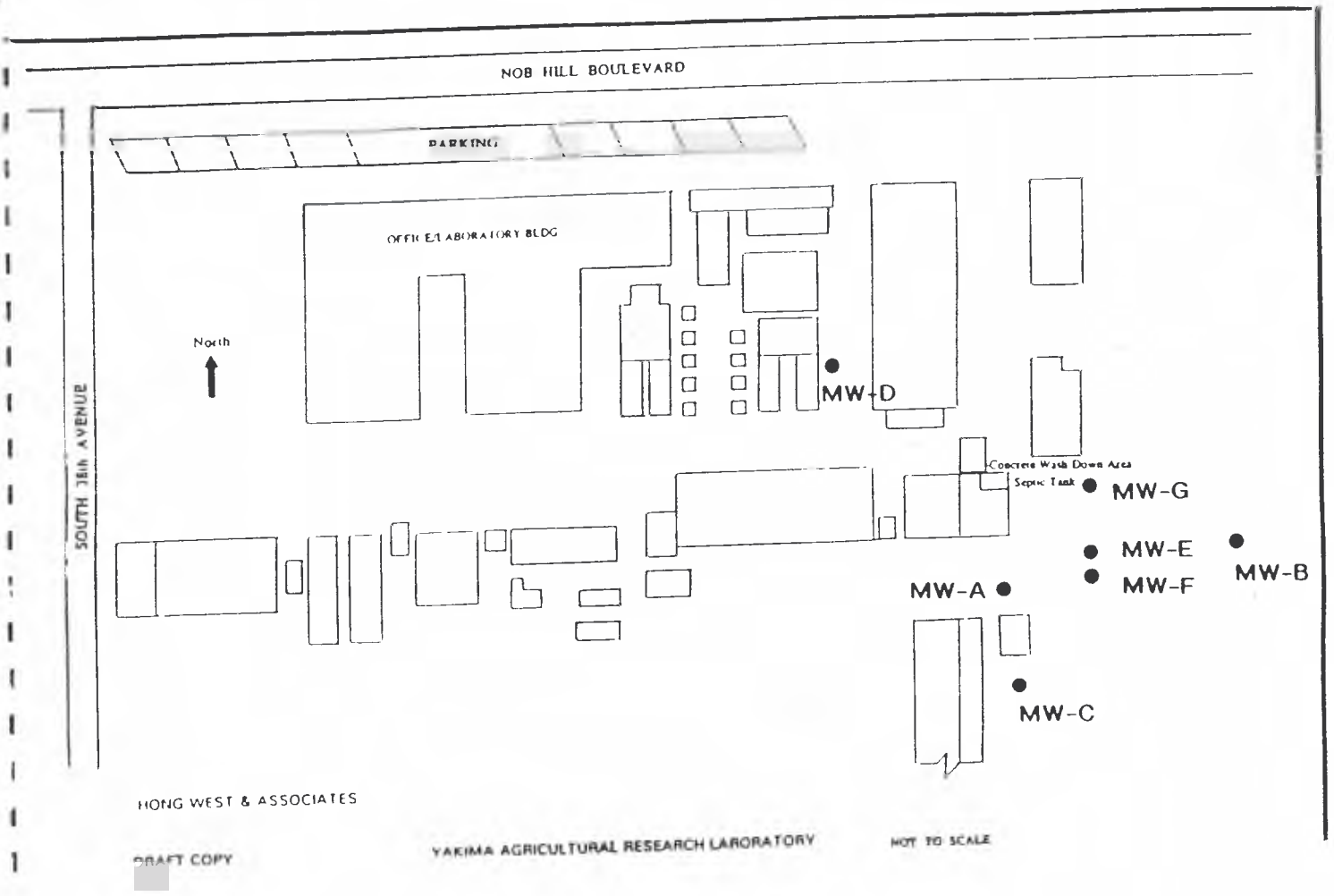
The YARL groundwater monitoring system consists of seven wells (MW-A through MW-G). Monitoring well locations are shown in Figure 2. Monitoring well MW-D is located upgradient, while all of the other wells are either cross-gradient or downgradient of the septic tank and drainfield, depending on variations in the direction of groundwater flow (Tetra Tech 1989). Monitoring well MW-E was installed as a piezometer at a depth of 125 feet bgs near the bottom of the shallow alluvial aquifer in order to generate information regarding vertical hydraulic and chemical gradients within the upper aquifer (Hong West and Associates, 1990a). All of the other wells are screened in uppermost 10 feet of the shallow aquifer.

FIGURE 1 LOCATION MAP OF YAKIMA AGRICULTURAL RESEARCH LABORATORY



From Tetra Tech (1989)

FIGURE 2 YARL WELL LOCATION MAP



Modified from Hong West and Associates (1990a)

5.0 SITE INSPECTION

On May 6, 1991, Ben Farrell, geologist, and Julie Howe, environmental scientist, conducted an operation and maintenance inspection at YARL. The inspection corresponded to the fourth quarterly groundwater sampling event as described in the facility project plan (Hong West and Associates 1990a). The weather was generally sunny with temperatures ranging between 60-70°F. PRC personnel observed sampling procedures at the following wells: MW-A, MW-B, MW-C, MW-D, MW-E, MW-F, and MW-G. Split-groundwater samples were received by PRC personnel from monitoring wells MW-D, MW-G, MW-A, MW-F, and MW-E. A photographic log of the site visit is presented in Appendix A. Sweet-Edwards/EMCON field notes, PRC field notes, an operation and maintenance inspection checklist, a YARL analytical data summary, a PRC analytical data summary, and potentiometric surface maps are presented in Appendices B through G, respectively.

5.1 WELL MAINTENANCE AND ABOVE-GROUND WELL CONSTRUCTION

The above-ground portion of the monitoring wells appeared to be adequately maintained. Monitoring well MW-D was constructed to grade because of heavy traffic in that portion of the YARL site. The lid to the protective casing was secured and required an allen wrench to be opened, but was not locked. Rust visible on the well cap indicated the probability of moisture collecting inside the well vault. With the exception of monitoring well MW-D, all of the other inspected wells were securely locked. The wells constructed above the ground were surrounded by a three protective posts approximately 3 feet high, and had lockable protective outer casings. Each well was surveyed at a marked point on the top rim of the outer well casing. None of the inspected wells were labeled. The protective outer casing was set into a triangular concrete pad. In all cases, the concrete pad was slightly raised above the ground surface and fit tightly against the protective outer casing. The top of the polyvinyl chloride (PVC) inner casing was covered by a well cap attachment used for the connection of the dedicated pump and automatic controller.

5.2 GROUNDWATER PUMPS

A dedicated well wizard[tm] bladder pump was used to sample all wells. The pump was connected to a model 3013 automatic controller that supplied pressurized nitrogen as the pump gas. The pressurized nitrogen was used to ensure that no ambient air contaminated the groundwater samples.

5.3 WATER-LEVEL MEASUREMENTS

Water levels were measured to the nearest 0.01 foot at all of the monitoring wells on the same day prior to sampling any of the wells. These measurements were not repeated after purging and sampling. Depth to water was measured with a Slope Indicator Inc. electronic probe. Total well depth was not measured. In accordance with the sampling and analysis plan, the well probe was decontaminated by rinsing the coiled tape and the probe tip with methanol and then twice with distilled water.

5.4 WELL PURGING AND ENVIRONMENTAL PARAMETERS

The monitoring wells were purged and sampled in the following order: MW-D, MW-G, MW-B, MW-A, MW-F, MW-E, and MW-C. As specified in the project sampling and analysis plan, the above order of sample collection is basically from upgradient to downgradient wells. Monitoring well MW-C was sampled last because of its prior history of volatile organic contamination.

The sampling and analysis plan stipulates that a minimum of five well casing volumes will be purged before the commencement of sampling. With the exception of monitoring well MW-G, three well casing volumes were purged at all of the inspected wells. After each well casing volume was discharged, a groundwater sample was analyzed for conductivity, pH, and temperature. Measurements of the conductivity and pH were made using a DSPH3 meter and temperature measurements were made using a Taylor model 21431 thermometer. The conductivity and pH meter was calibrated before sample collection was initiated at monitoring well MW-D. Results were tabulated on field data sheets (Appendix B). The sampling and analysis plan states that well purging will continue even beyond five well casing volumes until successive measurements of the field parameters fall within 10 percent. In general, the field groundwater parameters for the inspected wells stabilized by the collection of the third well casing volume. An exception to this trend occurred at monitoring well MW-G where four well casing volumes were collected. Well volumes were calculated on the field data sheets (Appendix B).

Purged groundwater was pumped into buckets of known volume and transferred into a 55 gallon drum for storage until the calculated purge volume was reached. The containerized purge water was left open on the facility premises to evaporate in the sun. It is possible that during the rainy season, the filled 55-gallon drums could overflow onto the ground surface.

5.5 SAMPLE COLLECTION

After well purging, groundwater samples were collected by the facility contractor using clean gloves. Split groundwater samples were collected for the following parameters and analyzed using methods specified in EPA (1986b):

- volatile organic compounds (SW-846 8240)
- organo-chlorine pesticides (SW-846 8080)
- chlorinated herbicides (SW-846 8150)
- organo-phosphorus pesticides (SW-846 8140)
- total metals (SW 846 methods 6010, 7470)

In accordance with the sampling and analysis plan, the facility collected a sample duplicate at monitoring well MW-D and a trip blank. All containers used by the facility contractor for the collection of volatile organics and metals were preserved by the laboratory prior to the sampling event. Volatile organic samples were preserved with concentrated hydrochloric acid, and metal samples were preserved with nitric acid.

Samples were collected in the following order: volatile organic compounds; pesticides and herbicides; and metals. The following sample containers were used for sample collection:

volatile organic compounds	2 x 40 mL glass vial
pesticides and herbicides	1 x 4 L amber glass jug
total metals	1 x 1 L polyethylene

The sampling and analysis plan specifies that all samples collected for metals analysis would be analyzed for filtered total metals rather than total metals. Results reported by the facility laboratory were for total metals only.

At monitoring well MW-D, the plastic pump outlet tube was too short to allow for the proper filling to the bucket used for purging and the large 4 liter containers used for pesticide samples. This situation caused potentially contaminated groundwater to be spilled on the ground. Also, during the collection of samples at this well, the sample container lips were periodically in contact with the pump outlet tube. In order to prevent container contamination, the sample containers should not come in contact with the pump discharge tube. A longer pump outlet tube should be installed at monitoring well MW-D.

During the collection of volatile organic samples, the pump rate was occasionally too high for the collection of representative samples. EPA (1986a) states that pump rates during volatile organic sample collection should not exceed 100 milliliter per minute (mL/minute). The observed

pump rate was considerably in excess of 100 mL/minute. The groundwater sampling stream was often quite aerated and preservatives were occasionally flushed from the sample containers. According to the facility contractor, the flow throttle on the automatic controller was not functioning properly. The facility contractor tried to control the flow rate by partially closing the valve to the pressurized nitrogen canister and by adjusting the refill and discharge controls on the automatic controller.

During the collection of volatile organic analysis (VOA) vials, the septa fell out of VOA vials repeatedly during sampling. Because no extra VOA vials were brought along by the facility contractor, the septa were decontaminated using distilled water and were then used for the collection of samples.

Sample containers were labelled in the field prior to sampling. After sampling, the containers were placed in coolers with ice. Discussions with the facility contractor's personnel revealed that after sample collection, a chain-of-custody form is placed in each cooler and the cooler is sealed with chain-of-custody seals. Samples were shipped the same day via Federal Express to Biospherics Inc. in Beltsville, Maryland for chemical analysis.

6.0 FACILITY ANALYTICAL DATA

Facility analytical data for the May 6, 1991 sampling event is summarized in Hong West and Associates (1991c). The data summary table from the above report is included as Appendix E. Several metal compounds were detected above quantitation limits. The concentrations of calcium, sodium, magnesium, and potassium are relatively high (NAS 1977). These metals are also present in the upgradient well and are not considered site-related contaminants. These relatively high background concentrations could be related to local agricultural practices. A concentration of 3.5 µg/L lead was detected in monitoring well MW-A. Concentrations of volatile organic compounds, herbicides, and pesticides were below the laboratory quantitation limits.

7.0 PRC ANALYTICAL DATA

A summary of results for the split groundwater samples received by PRC for the YARL are shown in Appendix F. In an effort to meet quality assurance/quality control objectives, PRC submitted a trip blank, and an environmental duplicate as well as a matrix spike/matrix spike duplicate for chemical analysis. Data was validated using the guidelines established by EPA (1988a,b). For a complete description of the data validation for the split groundwater samples analyzed for the YARL site see the data validation report (PRC 1991).

Split sample inorganic analytical results indicate relatively high concentrations of calcium, sodium, magnesium, and potassium similar to those reported by the facility contractor. Arsenic and lead were present at low concentrations (a maximum of 7.2 µg/L and 17.2 µg/L respectively) in groundwater samples from both upgradient and downgradient wells. The facility contractor did not find arsenic in concentrations above the laboratory quantitation limit. However, the laboratory quantitation limit of the facility laboratory for arsenic (10 µg/L) is higher than the values for the split samples. The facility contractor found lead at a concentration of 3.5 µg/L in monitoring well MW-A. Split groundwater samples from this well yielded the highest concentrations of lead (17.2 µg/L) found at the YARL site.

Split sample results for volatile organic compounds showed low concentrations of methylene chloride, acetone, tetrachloroethene, and chloroform. Concentrations of all of these compounds were estimated below the practical quantitation limit and were qualified J. Methylene chloride is a common laboratory contaminant and was only found in the trip blank. Acetone was found at very low concentrations from two of the monitoring wells and is also a common laboratory contaminant. Tetrachloroethene was found only in very low concentrations in two of the wells. The upgradient well (MW-D) showed the highest concentration (3 µg/L) of this compound. Chloroform was found at very low concentrations (1-3 µg/L) in all of the downgradient wells, but not in the upgradient well. The distribution of chloroform in the downgradient wells at YARL suggests that it may be a site related contaminant. The detected concentrations are significantly below proposed subpart S action levels (55 FR 30798) and the Model Toxic Control Act Method A cleanup levels for groundwater codified in WAC 173-340-720(2).

For pesticides and herbicides, split sample results show the presence of endosulfan sulfate in low concentrations (0.1-0.2 µg/L) in all of the downgradient wells, but not in the upgradient well. The distribution of endosulfan sulfate suggests that it is a site related contaminant. Analysis of split samples indicated low levels of contamination that were not reported by the facility laboratory. In all such cases, the facility laboratory did not report results below the quantitation limit. However, the EPA contract laboratory reported results below the quantitation limit and greater than the method detection limit as estimates, which are designated J. This suggests that very low levels of groundwater contamination could occur and not be detected by the analytical testing program of the facility.

8.0 HISTORICAL ANALYTICAL DATA

Data from the August 1990 round of groundwater sampling (Round 1) showed low levels of mercury contamination below the maximum contaminant level for drinking water established in 40 CFR 264.93 (Hong West and Associates 1990b). During the November 14, 1990 round of groundwater monitoring (Round 2), the following pesticide compounds were detected in

groundwater from the YARL site: malathion, heptachlor, 4,4'-DDT, and heptachlor epoxide (Hong West and Associates 1991a). None of these compounds have been detected subsequently. Analytical data collected during a September 1988 comprehensive groundwater monitoring evaluation showed detectable concentrations of chloroform (1-12 μg/L) in downgradient wells MW-A, MW-B, and MW-C (Tetra Tech 1989). Arsenic was also detected (26 μg/L) during the comprehensive groundwater monitoring evaluation sampling event in monitoring well MW-A (Tetra Tech 1989).

The split samples collected by PRC confirm the presence of site related chloroform in the groundwater. Though arsenic was detected at low levels in the most recent split samples and has been detected in samples from downgradient monitoring wells at the facility in the past, it is not clear that arsenic is a site related contaminant because it was also found in groundwater samples from the upgradient well.

9.0 GROUNDWATER SITE CHARACTERIZATION

The EPA approved closure plan and the project work plan states that the facility will characterize the uppermost aquifer and assess the hydraulic interconnection of the uppermost and next lower aquifer. In addition, the Code of Federal Regulations 40 CFR 265.94 (b)(2) stipulates that for facilities showing groundwater contamination the rate and extent of migration of the hazardous waste constituent in the groundwater must be documented yearly. The rate and extent of contamination cannot be documented without a complete characterization of the site hydrogeology. PRC notes the following shortcomings in the hydrogeologic site characterization.

Potentiometric surface maps have been constructed on a monthly basis since August 1990 (Appendix G). These maps show that the direction of groundwater flow is variable, ranging from nearly easterly flow to nearly southerly flow. The cause of the fluctuations in groundwater flow direction, while presumably related to irrigation practices, has not been documented. The facility should evaluate the effect of nearby irrigation wells and ditches on the direction of groundwater flow.

The potentiometric surface maps prepared by the facility contractor also show a level of certainty and detail not possible from the collected data. Where approximated, potentiometric surface lines should drawn as dashed rather than solid lines. Monitoring wells MW-E and MW-B were not used in the creation of the potentiometric surface maps. Monitoring well MW-E was legitimately excluded because of the screened interval of the well was deep in the upper aquifer. Monitoring well MW-B was excluded because water-level data from this well consistently produced anomalous flow patterns (Hong West and Associates 1991a,b,c). Monitoring well MW-

B is constructed with the well screen placed at the same depth and intersecting similar lithology as the other shallow monitoring wells, and appears to be constructed in the same manner (Biospherics 1988). Rather than excluding the anomalous water level data for monitoring well MW-B, the cause for the anomalous water level data should be determined and reported.

A consistent upward vertical hydraulic gradient has been determined by comparing water levels measured at shallow monitoring wells MW-F and the deeper piezometer MW-E. The vertical hydraulic gradient has averaged roughly .01 ft/per ft upward. An exception to this trend occurred in July of 1991 where the upward vertical hydraulic gradient was .028 ft/per ft (Hong West and Associates, 1991c). These results suggest that the well locality is within a zone of groundwater discharge. Caution should be exercised when interpreting these results as an upward vertical gradient has not been documented across the entire site.

The degree of interconnection between the shallow aquifer and deeper aquifers below the site has not been established at the site. Furthermore, the lower aquifer has not been well defined.

10.0 SUMMARY AND RECOMMENDATIONS

PRC assessed all of the monitoring wells at the YARL site and determined that the maintenance and above-ground construction of the monitoring wells, and the sampling protocols used by the facility contractor were generally adequate to ensure the collection of representative groundwater samples. In accordance with 40 CFR 265.92, the sampling and analysis plan provides adequate procedures and techniques for groundwater sample collection, sample preservation and shipment, analytical procedures, and chain-of-custody control.

PRC makes the following recommendations regarding field sampling procedures observed during the site visit:

- The pump rate observed during the collection of volatile organic compounds was commonly too high. The facility contractor should reduce the pump rate to minimize the potential for sample volatilization.
- The teflon tubing connected to the pump discharge outlet was too short at monitoring well MW-D. Because of this situation, potentially contaminated groundwater was spilled on the ground surface, and the lip of sample containers was allowed to contact the teflon tubing. A longer length of tubing should be installed.
- Purge water collected in drums should be covered until chemical analysis has been completed.

- The facility contractor should have extra glassware available during sampling.
- Total well depth was not measured during the sampling event. The sampling and analysis plan states that total well depth would be monitored on a monthly basis. In accordance with EPA (1986a), total well depth should be measured regularly in order to monitor the wells for siltation problems and well integrity.

The facility contractor found no pesticide or volatile organic contamination during the May 6, 1991 Round 9 groundwater sampling. Metals such as calcium, sodium, magnesium, and potassium were detected by the facility contractor at relatively high concentrations in both upgradient and downgradient wells. These relatively high background concentrations could be related to local agricultural practices. A concentration of 3.5 µg/L lead was detected in one of the downgradient monitoring wells, MW-A.

Results from split samples collected by PRC show low concentrations of lead and arsenic in groundwater samples from both upgradient and downgradient wells at the YARL site. The arsenic was detected in concentrations below the quantitation limits of the facility laboratory. Concentrations of metals such calcium, sodium, magnesium, and potassium were detected in close to the same concentrations as those reported by the facility contractor. No significant differences were found between split sample dissolved and total metals analysis, indicating that most of the metals are dissolved in the groundwater. Split sample results also show low concentrations of chloroform and endosulfan sulfate in all of the downgradient monitoring wells, but not in upgradient monitoring well MW-D. However, both of the contaminants were found in concentrations below the quantitation limit of the facility laboratory.

The good comparibility between independently analyzed EPA and facility analytical data suggests that the facility analytical program is adequate. The detection of contaminants below the facility laboratory quantitation limits by the EPA approved laboratories shows the potential for very low levels of groundwater contamination to exist and not be detected by the facility laboratory.

The EPA-approved closure plan states that the facility will completely characterize the YARL site hydrogeology and assess the interconnection of the upper and lower aquifers at the site. PRC notes the following deficiencies regarding the YARL hydrogeologic site characterization:

- Anomalous water level measurements at monitoring well MW-B should be explained rather than disregarded.

- The cause for the monthly variations in the groundwater flow direction should be investigated. The facility should evaluate the seasonal use of nearby irrigation wells and ditches to determine whether irrigation practices are affecting groundwater flow direction at the site.

- The degree of interconnection between the upper alluvial aquifer and underlying aquifers has not been established. At a minimum, the facility should define and more completely characterize the underlying aquifers through examination of well logs or permits for local water supply wells and discussion with parties involved in groundwater monitoring or supply of groundwater locally.

11.0 REFERENCES

Biospherics 1988. Preliminary Soil and Groundwater Investigation of the United States Department of Agriculture Research Laboratory in Yakima, Washington. December 23, 1988.

EPA 1986a. Groundwater Monitoring Technical Enforcement Guidance Document, OSWER-9950.1. U.S. Environmental Protection Agency. September 1986.

EPA 1986b. Test Methods for Evaluating Solid Waste, SW-846. Third Edition. U.S. Environmental Protection Agency. November 1986.

EPA 1988a. Laboratory Data Validation Functional Guidelines for Evaluation of Organic Analyses. U.S. Environmental Protection Agency, Hazardous Site Evaluation Division. February 1988.

EPA 1988b. Laboratory Data Validation Functional Guidelines for Evaluation of Inorganic Analyses. U.S. Environmental Protection Agency, Hazardous Site Evaluation Division. July 1988.

Hong West and Associates 1990a. Disposal of the Hazardous Waste Septic System in Yakima, Washington: Project Plan. April 23, 1990.

Hong West and Associates 1990b. Quarterly Groundwater Monitoring Report, Yakima Agricultural Research Laboratory, Quarter Number 1-August 1990. November 2, 1990.

Hong West and Associates 1991a. Quarterly Groundwater Monitoring Report, Yakima Agricultural Research Laboratory, Quarter Number 2-November 1990. January 23, 1991.

Hong West and Associates 1991b. Quarterly Groundwater Monitoring Report, Yakima Agricultural Research Laboratory, Quarter number 3-April 1991. May 3, 1991.

Hong West and Associates 1991c. Quarterly Groundwater Monitoring Report, Yakima Agricultural Research Laboratory, Quarter Number 4-May 1991. July 30, 1991.

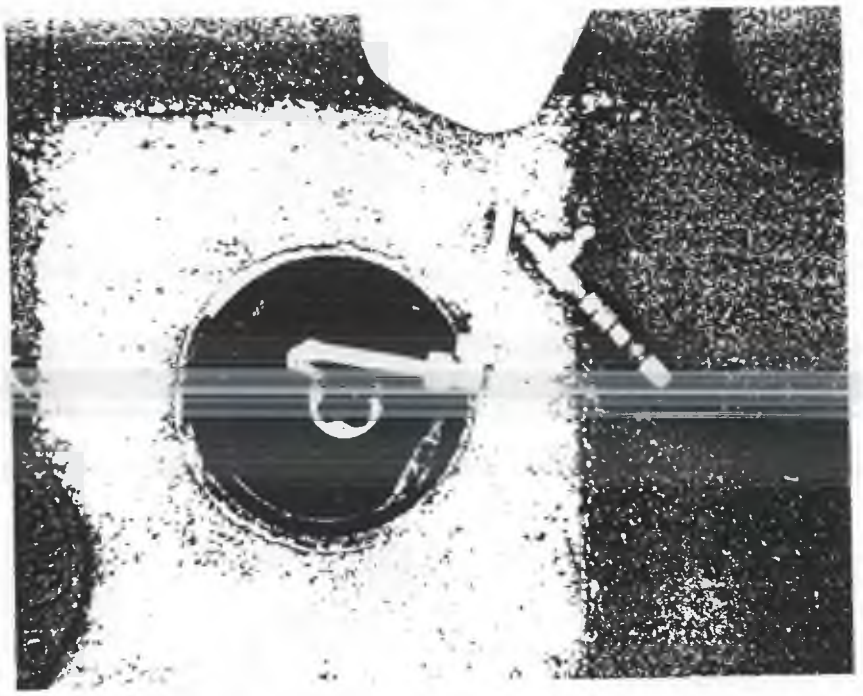
NAS 1977. Drinking Water and Health. National Academy of Sciences. 937 pp.

PRC 1991. Yakima Agricultural Research Laboratory, Yakima Washington, Draft Operation and Maintenance Inspection Data Validation Report. Prepared by PRC Environmental Management, Inc. for U.S. Environmental Protection Agency, Region 10. July 15, 1991.

Tetra Tech 1989. Draft Report RCRA Comprehensive Groundwater Monitoring Evaluation, Yakima Agricultural Research Laboratory, Yakima Washington. February 1989.

APPENDIX A PHOTOGRAPHIC LOG

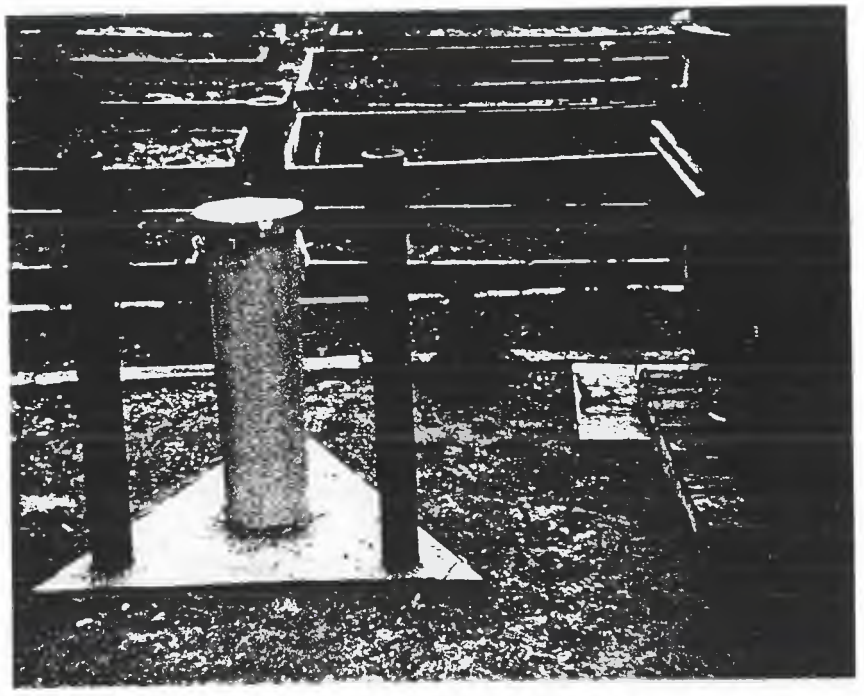
Photo No. 1



Date: May 6, 1991 Picture Taken By: Julie Howe Direction Facing: N/A

Picture Description: Monitoring well MW-D. Note flush mount, teflon tubing, and distilled water container.

Photo No. 2



Date: May 6, 1991 Picture Taken By: Julie Howe Direction Facing: East

Picture Description: Monitoring well MW-G.

Photo No. 3

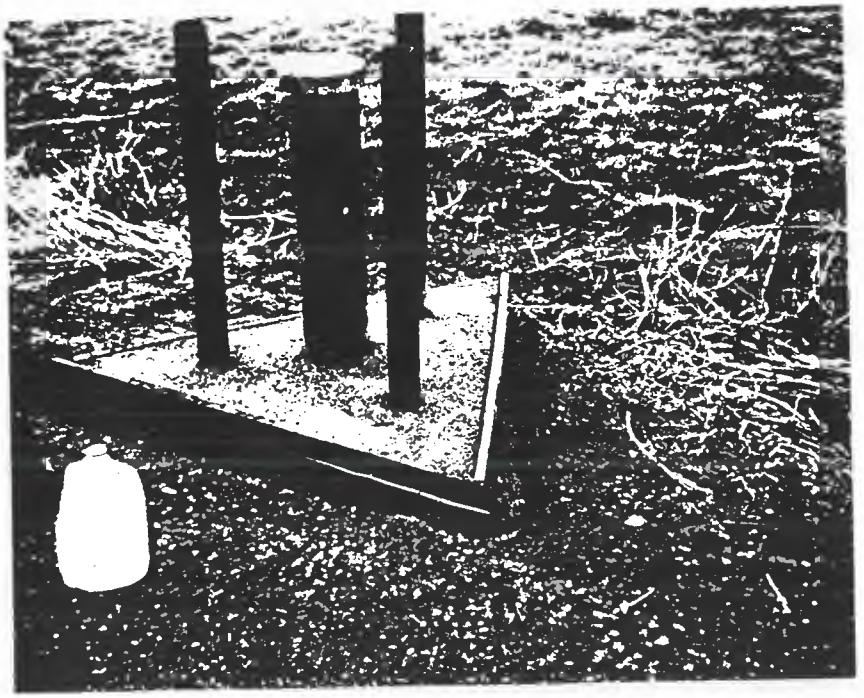
Date: May 6, 1991

Picture Taken By: Julie Howe

Direction Facing: N/A

Picture Description: Purging at monitoring well MW-G.

Photo No. 4



Date: May 6, 1991 Picture Taken By: Julie Howe Direction Facing: N/A

Picture Description: Monitoring well MW-B.

Photo No. 5

Date: May 6, 1991 Picture Taken By: Julie Howe Direction Facing: N/A

Picture Description: Purging at monitoring well MW-B.

Photo No. 6

Date: May 6, 1991

Picture Taken By: Julie Howe

Direction Facing: South

Picture Description: Taking water-level measurement at monitoring well MW-A.

Photo No. 7

Date: May 6, 1991 Picture Taken By: Julie Howe Direction Facing: N/A

Picture Description: Close-up of monitoring well MW-A.

Photo No. 8

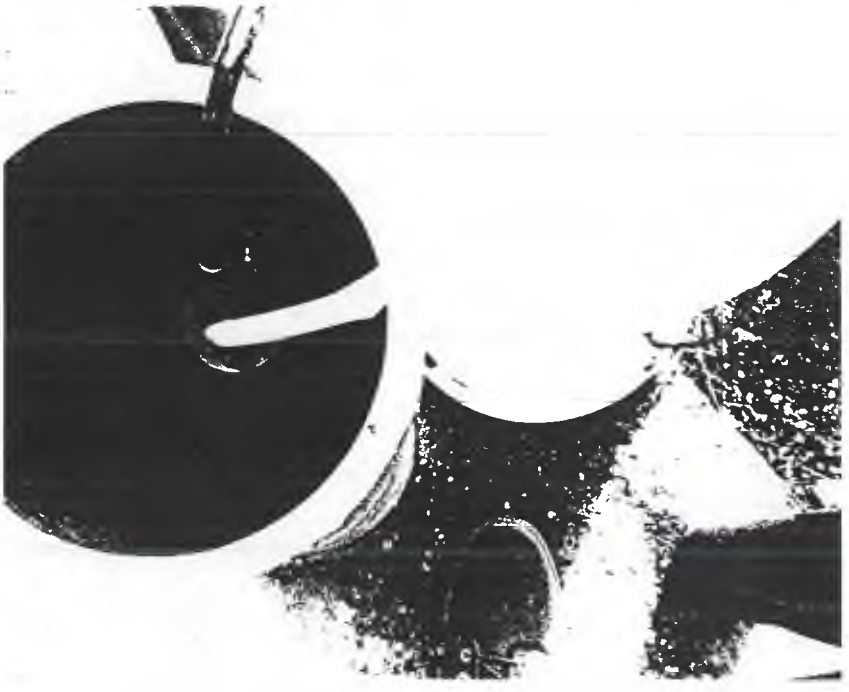
Date: May 6, 1991 Picture Taken By: Ben Farrell Direction Facing: East

Picture Description: Purging at monitoring well MW-E (left) and protective casing of monitoring well MW-F (right).

Photo No. 9

Date: May 6, 1991 Picture Taken By: Ben Farrell Direction Facing: Southeast

Picture Description: Piezometer MW-E.



Date: May 6, 1991 Picture Taken By: Ben Farrell Direction Facing: N/A

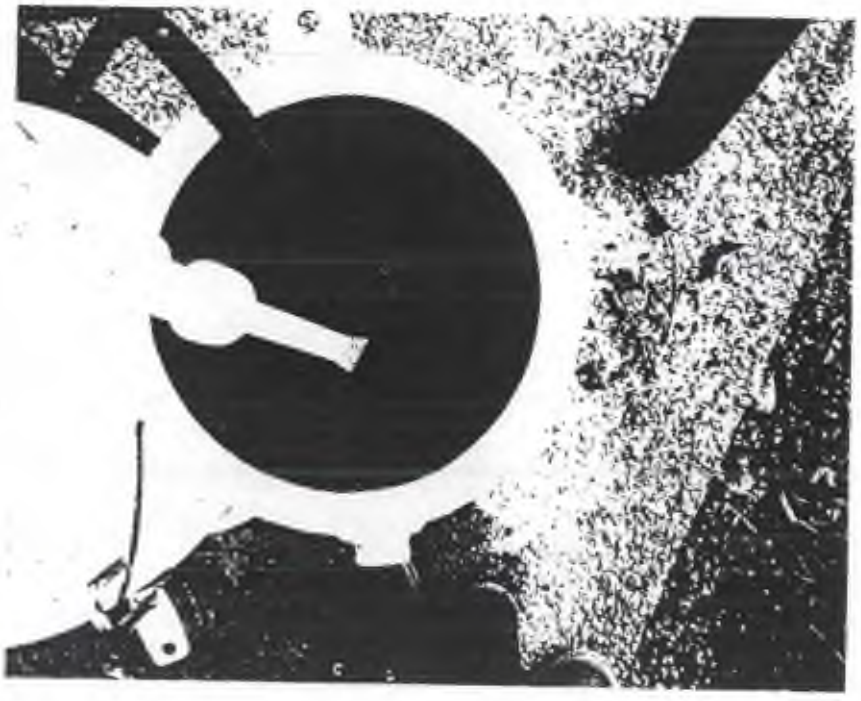
Picture Description: Pureing at piezometer MW-E.

Photo No. 11

Date: May 6, 1991 Picture Taken By: Ben Farrell Direction Facing: East

Picture Description: Monitoring well MW-C. Note pallet resting against well casing.

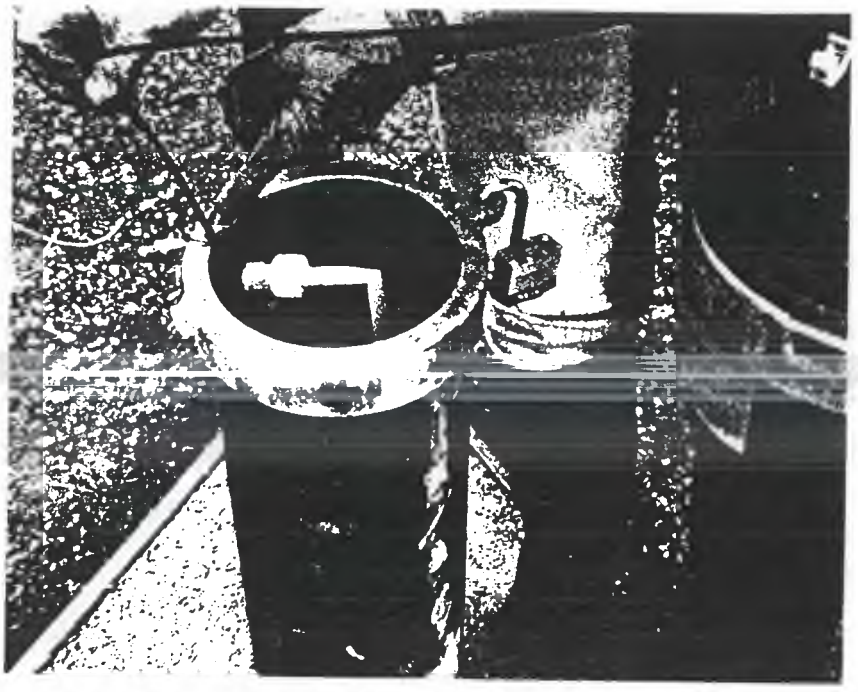
Photo No. 12



Date: May 6, 1991 Picture Taken By: Ben Farrell Direction Facing: N/A

Picture Description: Interior of casing at monitoring well MW-C.

Photo No. 13



Date: May 6, 1991 Picture Taken By: Julie Howe Direction Facing: N/A

Picture Description: Taking water-level measurement at monitoring well MW-B. Water level is measured at surveyed mark on casing rim as shown in the photograph.

Date: May 6, 1991 Picture Taken By: Julie Howe Direction Facing: N/A

Picture Description: Taking water-level measurement at monitoring well MW-C.

Photo No. 15

Date: May 6, 1991 Picture Taken By: Julie Howe Direction Facing: West

Picture Description: Methanol rinse of probe at monitoring well MW-E.

Photo No. 16

Date: May 6, 1991

Picture Taken By: Julie Howe

Direction Facing: N/A

Picture Description: Nitrogen canisters and pump compressor.

Photo No. 17

Date: May 6, 1991 Picture Taken By: Julie Howe Direction Facing: N/A

Picture Description: Sampling for conductivity, pH, and temperature at monitoring well MW-D.

Photo No. 18

Date: May 6, 1991

Picture Taken By: Ben Farrell

Direction Facing: South

Picture Description: Purging at monitoring well MW-C.

Photo No. 19

Date: May 6, 1991

Picture Taken By: Ben Farrell

Direction Facing: N/A

Picture Description: pH and conductivity meter and container used to sample environmental parameters. Meter sensors were allowed to rest on dirty truck bed without subsequent decontamination.

Photo No. 20

Date: May 6, 1991

Picture Taken By: Ben Farrell

Direction Facing: West

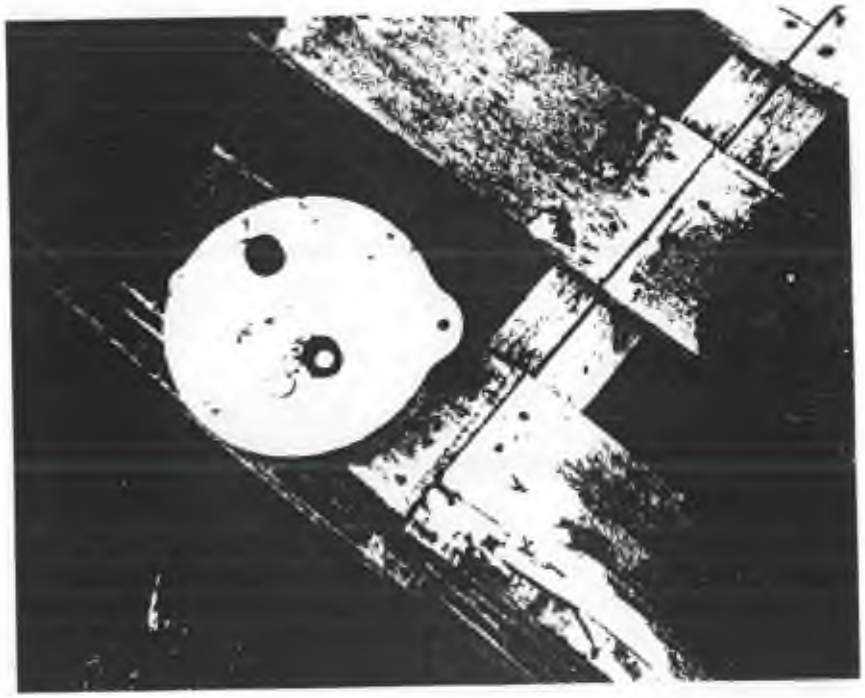
Picture Description: Measuring pH, temperature, and conductivity at monitoring well MW-C.

Photo No. 21

Date: May 6, 1991 Picture Taken By: Ben Farrell Direction Facing: N/A

Picture Description: Collecting volatile organic samples at monitoring well MW-D.

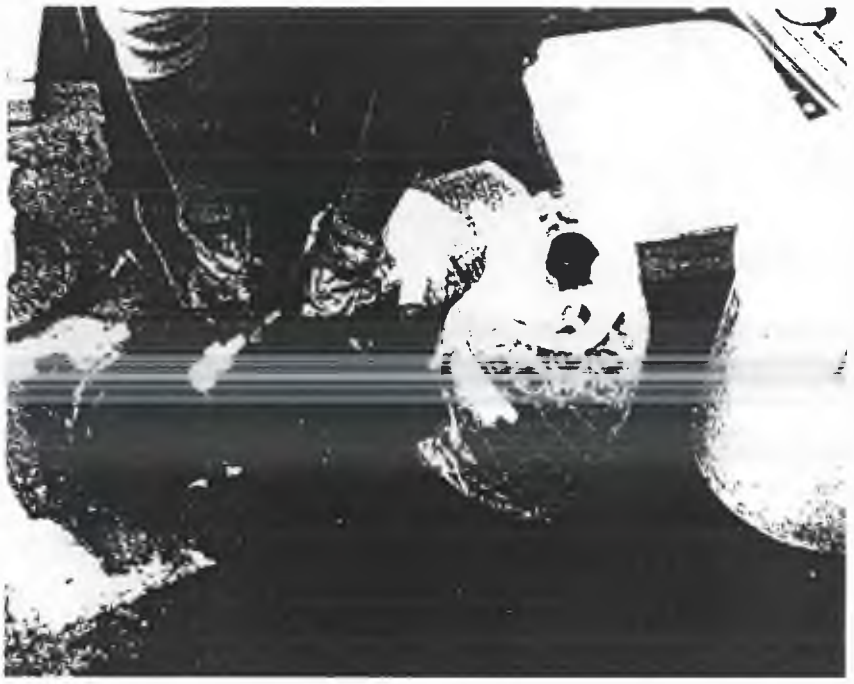
Photo No. 22



Date: May 6, 1991 Picture Taken By: Ben Farrell Direction Facing: N/A

Picture Description: VOA vial showing septum that fell out of vial cap.

Photo No. 23



Date: May 6, 1991 Picture Taken By: Julie Howe Direction Facing: N/A

Picture Description: Filling pesticide samples at monitoring well MW-D. Note that the pump discharge tube is in contact with bottle opening.

Photo No. 24

Date: May 6, 1991

Picture Taken By: Ben Farrell

Direction Facing: West

Picture Description: Collecting sample for metals analysis at monitoring well MW-C.

Photo No. 25

Date: May 6, 1991 Picture Taken By: Ben Farrell Direction Facing: West

Picture Description: Photograph of old drainfield area showing excavated soil piles. Monitoring well MW-E in foreground.

APPENDIX B SWEET-EDWARDS/EMCON FIELD NOTES

Sweet-Edwards/EMCON, Inc.
13812 North Creek Parkway, Suite 210 • Bothell, WA 98011
Office (206) 485-5000 • FAX (206) 486-9766

Field Sampling Data

Duplicate

LOCATION/ADDRESS Yakima Agricultural Research Lab.
PROJECT NAME Quarterly Sampling #1/25-21-03
CLIENT/CONTACT Doug Gilles (Hanna West)

Well or Surface Site Number MW-D
Sample Designation 90042-0591-D
Date, Time 5/6/91 0915
Weather Partly Sunny ≈ 50°F

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft.)	Elevation	Date, Time	Method Used (M-Scope Number or Other)
34.73		0736 5/6/91	Slope Indicator #15227

WELL EVACUATION:

Gallons	Pore Volumes	Method Used	Rinse Method	Date, Time
6	3	Well Wizard	–	5/6/91 0835 – 0915

Surface Water Flow Speed ______ Measurement Method ______ Date, Time ______

SAMPLING: Well Wizard

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes,no)	Preservative	Iced (yes,no)
VOA	5/6/91	8240	2x 40ml	Glass		N	HCl	Y
Pesticides		8150 8080	1 liter	Amber glass		N	None	Y
		8140				N		Y
metals	0915	6010	1 liter	poly		N	HNO3	Y
		7470-Hg						

Sample Cleaning Method: Non-Phosphate detergent wash, H2O rinse, MeOH rinse, Distilled H2O rinse

FIELD WATER QUALITY TESTS:

Pore Vol. Number	pH	Conductivity	Temp °C	gallons
1	7.03	963	14°	2
2	7.35	923	14°	4
3	7.53	919	14°	6

NOTES:

Depth – 46' – 35 = 11 ÷ 6 = 2

Clear, Colorless, no characteristic Odor

– Tubing on Well is not long enough to reach Collection bucket – allow proper Sampling (should be ≈ 3 ft. longer)

– VOA 90042-0591-D2 – 1 vial lid was incomplete – extra VOA's not available – none at all Duplicate Set

pH – were calibrated to 720 umhos, 7.00 pH, & 4.00 pH – Pre-calibrated

* Duplicate Sample # 90042-0591-D2 | Total Dissolved metals ... / Pest.

Metals – Pb, As, Cd, Hg – method 6010, method 7470 Hg

Total # of Bottles 4

Signature Rebecca L. Hyllund

Sweet-Edwards/EMCON, Inc.
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Field Sampling Data

LOCATION/ADDRESS Yakima Agricultural Research Lab
PROJECT NAME Quarterly Sampling #W25-01.03
CLIENT/CONTACT Doug Geller (Hong West)

Well or Surface Site Number MW-6
Sample Designation 9042-0591-6
Date, Time 5/6/91 1020
Weather Cloudy 55°F

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft.)	Elevation	Date, Time	Method Used (M-Scope Number or Other)
32.68		0743 5/6/91	Slope Indicator #1522

WELL EVACUATION:

Gallons	Pore Volumes	Method Used	Rinse Method	Date, Time
6.8	3+	Well Wizard		5/6/91 0945-1020

Surface Water Flow Speed ______ Measurement Method ______ Date, Time ______

SAMPLING:

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes,no)	Preservative	Iced (yes,no)
VOA	5/6 1020	Well Wizard	2/40ml	Glass		N	HCl	Y
Pesticides			4000ml	Amber Glass		N	None	
Metals			1000ml	Poly		N	HNO3	

Sample Cleaning Method: Non-Phosphate detergent wash, H2O rinse, MeOH rinse, Distilled H2O rinse

FIELD WATER QUALITY TESTS:

Pore Vol. Number	pH	Conductivity	Temp °C	Gallons
1	8.16	579	14.5	2
2	7.94	598	14.5	4
3	7.53	686	14.5	6
4	7.88	701	14.5	8

NOTES:

Depth - 50' - 38 = 12 x .6 = 7

- Clear Colorless no characteristic odor

- One VOA Bottle lid Came apart - Center piece - rinsed with well water & replaced [illegible] - 4 Des! ID [illegible] [illegible]
[illegible]

Total # of Bottles: 4

Signature [illegible]

[illegible]

SEA-400-01

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Field Sampling Data

LOCATION/ADDRESS Yakima Agricultural Research Lab
PROJECT NAME Quarterly Sampling W25-91-02
CLIENT/CONTACT Doug Feller (Ecology)

Well or Surface Site Number MW-C
Sample Designation 9105W2-0591-C1
Date, Time 5/6/91 1650
Weather Sunny, Clouds ≈ 65°

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft)	Elevation	Date, Time	Method Used (M-Scope Number or Other)
36.55		5/6/91 0811	Slope Indicator #15227

WELL EVACUATION:

Gallons	Pore Volumes	Method Used	Rinse Method	Date, Time
3	3?	bail removed		1636 5/6/91 - 1650

Surface Water Flow Speed _____ Measurement Method _____ Date, Time _____

SAMPLING:

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes,no)	Preservative	Iced (yes,no)	Sample Cleaning Method
VOA	5/6	bail	3x40	glass		N		Y	Non-Phosphatic detergent wash H2O rinse MeOH rinse Distilled H2O rinse
O&G			4x1L	glass		N		Y	
Methods			1000	poly		N		Y	
	1650								

FIELD WATER QUALITY TESTS:

Pore Vol. Number	pH	Conductivity	Temp	Observations
1	7.71	890	15°	
2	7.71	970	15°	
3	7.68	997	15°	

NOTES:

Depth - 37' - 37 = 5/6/91

- Clear Colorless, no characteristic Color.

PRC will not collect samples from this well.

Total # of Bottles 5 Signature _____

SEA-400-01

Sweet-Edwards/EMCON, Inc.
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Office (206) 486-5000 • FAX (206) 486-9766

Field Sampling Data

LOCATION/ADDRESS Yakima Agricultural Research Lab
PROJECT NAME Groundwater Sampling # WES-01.02
CLIENT/CONTACT Doug Geller (Ecology West)

Well or Surface Site Number Field Blank
Sample Designation 90042-0591-01
Date, Time 5/6/91 1040
Weather Sunny ~65°F

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft)	Elevation	Date, Time	Method Used (M-Scope Number or Other)

WELL EVACUATION:

...ions	Pore Volumes	Method Used	Rinse Method	Date, Time

Surface Water Flow Speed _____ Measurement Method _____ Date, Time _____

SAMPLING:

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes,no)	Preservative	Iced (yes,no)	Sample Cleaning Method
									Non Phosphatic detergent wash H2O rinse MeOH rinse Distilled H2O rinse

FIELD WATER QUALITY TESTS:

Pore Vol Number	pH	Conductivity	Temp	DO				
	8.51	008	17					

NOTES:

De-ionized water was poured into sampling bottles from a glass carboy.

Total # of Bottles: 4 Signature: Rebecca J. Hyllegard

SEA-400-01

Lab

Sweet-Edwards/EMCON, Inc.
18912 North Creek Parkway, Suite 210 • Bothell, WA 98011
Office (206) 485-5000 • FAX (206) 486-9766

Field Sampling Data

LOCATION/ADDRESS Yakima Horticultural Research Lab
PROJECT NAME Ground Water Sampling # W25-01-03
CLIENT/CONTACT Doug Geller (Hong West)

Well or Surface Site Number MW-A
Sample Designation 92042-0591-A1
Date, Time 5/6/91 1145
Weather Cloudy ~55°F

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft.)	Elevation	Date, Time	Method Used (M-Scope Number or Other)
36.97		0751 5/6/91	Slope Indicator #15227

WELL EVALUATION:

Gallons	Pore Volumes	Method Used	Rinse Method	Date, Time
3	2	Well Wizard		5/6/91 1120-1145

Surface Water Flow Speed _____ Measurement Method _____ Date, Time _____

SAMPLING:

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes,no)	Preservative	Iced (yes,no)
VOA	5/6		40x3	3 VOA		N	HCl	Y
Diss			1x1L	1 Amber 1L		N	none	
metals			1x1L	1 plastic		N	HNO3	
	1145							

Sample Cleaning Method: Non-Phosphate detergent wash; H2O rinse; MeOH rinse; Distilled H2O rinse

FIELD WATER QUALITY TESTS:

Pore Vol. Number	pH	Conductivity	Temp °C	pH gallons				
1	6.33	1106	15°C	1				
2	7.15	1017	15°C	2				
3	7.32	1034	15°C	3				

NOTES:

Depth - 42' - 37' = 5' - 6" - 1"

DO - Collected 4 Sets VOA, 1 to Pesticides, 3 metals, 4 Diss metals

Effervescence present in VOA Samples

Depth Meter - recalibrated - 7.00 pH & 4.00 pH

Total # of Bottles: 4

Signature: _____

SEA-400-01

Sweet-Edwards/EMCON, Inc.
19912 North Creek Parkway, Suite 210 • Bothell, WA 98011
Office (206) 485-5000 • FAX (206) 486-9766

Field Sampling Data

LOCATION/ADDRESS Yakima Agricultural Research Lab
PROJECT NAME Quarterly Sampling # 25-01-03
CLIENT/CONTACT Doug Geller (Ecology West)

Well or Surface Site Number MW-B
Sample Designation 9/1342-0591-B1
Date, Time 5/6/91 1105
Weather Cloudy ~55°F

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft.)	Elevation	Date, Time	Method Used (M-Scope Number or Other)
37.18		0242 5/6/91	Slope Indicator - #15223

WELL EVACUATION:

Gallons	Pore Volumes	Method Used	Rinse Method	Date, Time
45	3	well wizard		5/6/91 1045 - 1105

Surface Water Flow Speed _____ Measurement Method _____ Date, Time _____

SAMPLING:

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes,no)	Preservative	Iced (yes,no)	Sample Cleaning Method
VOA	5/6/91	well	40 ml	Glass		N	HCl	Y	Non-Phosphatic detergent wash
B.S.		2nd	1 Gallon	Amber Glass		N	None		H2O rinse
Metals			250	Poly		N	HNO3		MeOH rinse
	1105							Y	Distilled H2O rinse
	1105								

FIELD WATER QUALITY TESTS:

Pore Vol Number	pH	Conductivity	Temp °C	Gallons				
1	7.86	815	15	15				
2	7.21	934	14	3				
3	7.62	961	14	4.5				

NOTES:

Depth - 47' - 37' = 10' - ½ = 1.5

Clear, colorless, no characteristic odor

Did not collect samples from this well

Total # of Bottles 2

Signature: Diane Whitford

SEA-400 01

Sweet-Edwards/EMCON, Inc.
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Field Sampling Data

LOCATION/ADDRESS: Yakima Agricultural Research [illegible]
PROJECT NAME: [illegible] Sampling # W25-01-23
CLIENT/CONTACT: [illegible] (Hargwest)

Well or Surface Site Number: MW-E
Sample Designation: 90042-0591-E1
Date, Time: 5/6/91 1315
Weather:

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft.)	Elevation	Date, Time	Method Used (M-Scope Number or Other)
35.74		5/6/91 0803	

WELL EVACUATION:

Gallons	Pore Volumes	Method Used	Rinse Method	Date, Time
	3	Well Wizard		5/6/91 1320-1345
				5/6/91 1500-1613

Surface Water Flow Speed: ________ Measurement Method: ________ Date, Time: ________

SAMPLING:

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes,no)	Preservative	Iced (yes,no)
VOA	5/6 [illegible]	Well	2x40	Glass		N	HCl	Y
[illegible]		Wizard	1 gallon	[illegible] glass		N		Y
Metals			1000	Poly		N		Y
	1615							

Sample Cleaning Method: Non-Phosphatic detergent wash, H2O rinse, MeOH rinse, Distilled H2O rinse

FIELD WATER QUALITY TESTS:

Pore Vol. Number	pH	Conductivity	Temp	Gallons
1	7.46	699	15°C	16
2	7.97	738	15°C	32
3	7.99	733	15°C	48

NOTES:

Drum - 28' - 36 = 92 ÷ 6 = 16
- Clear Colorless no characteristic odor

[illegible] - Collected 2 sets VOA, 4 Pest, 2 Diss & 2 Tot Metals
1345 - [illegible] of Drum space - Called [illegible] @ [illegible] - Purchased 2 Steel drums from Steins - Started [illegible] @ 1500

Total # of Bottles: 4 Signature: [illegible]

[illegible]

SEA-400-01

Sweet-Edwards/EMCON, Inc.

18912 North Creek Parkway, Suite 210 • Bothell, WA 98011
Office (206) 486-5000 • FAX (206) 486-6766

Field Sampling Data

LOCATION/ADDRESS Yakima Agricultural Research Lab. Well or Surface Site Number MW-5
PROJECT NAME Quarterly Sampling #25-01103 Sample Designation 9MW2-0591-5
CLIENT/CONTACT Doug Geller (Hydrosc) Date, Time 5/6/91 1255
Weather Sunny 60° 15227

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft.)	Elevation	Date, Time	Method Used (M-Scope Number or Other)
36.75		5/6/91 0758	Slope Indicator #15227

WELL EVACUATION:

Gallons	Pore Volumes	Method Used	Rinse Method	Date, Time
6	3	Bailed		5/6/91 1235 - 1255

Surface Water Flow Speed _____ Measurement Method _____ Date, Time _____

SAMPLING:

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes,no)	Preservative	Iced (yes,no)	Sample Cleaning Method
VOA	5/6/91	bailed	40 x 3	glass		N		Y	Non-Phosphate detergent wash H2O rinse MeOH rinse Distilled H2O rinse
PEST			1 gallon	amber glass	1	N		Y	
METALS	1255		1000	poly	1	N		Y	

FIELD WATER QUALITY TESTS:

Pore Vol Number	pH	Conductivity	Temp °C	Gallons				
1	7.82	1030	15	2				
2	7.71	~~839~~ 1028	15	4				
3	7.60	1046	15	6				

NOTES:

Depth - 621.37 - 12.56 = 2

- Clear Colorless, no Characteristic odor

Pest - Collected - 1st VOA, 4th pest

Total # of Bottles 4 Signature: _____

SEA-400-01

OSPHERICS® INCORPORATED

12051 Indian Creek Ct.
Beltsville, MD 20705
(301) 369-3900

10842

Chain of Custody Record

Project: Quarterly Sampling Site: [illegible]
Client: [illegible] Phone: (206) 774-0106
Address: 18908 Hwy 99
Lynnwood, WA 98046
Sampler's Name/Firm: [illegible]
Phone: 425-5000 Sampler's Signature: [illegible]

				Preservative Used	HCl	None	None	None	HNO3	HNO3				
Sample Number	Date	Time	Matrix	No. of Containers	VOA 8240	Pesticide 8150	[illegible] 8080	[illegible] 8140	6010	7470 Hg				Remarks or Sample Location
942-0591-D1	5/6/91	0915	Water	4	X	X	X	X	X	X				
942-0591-D2	"	0915	"	3	X	X	X	X	X	X				
942-0591-G1	"	1020	"	4	X	X	X	X	X	X				
942-0591-B1	"	1105	"	4	X	X	X	X	X	X				
942-0591-A1	"	1145	"	4	X	X	X	X	X	X				
942-0591-F1	"	1255	"	4	X	X	X	X	X	X				
942-0591-E1	"	1613	"	4	X	X	X	X	X	X				
942-0591-C1	"	1615	"	4	X	X	X	X	X	X				
942-0591-01 fld blank	"	1710	"	4	X	X	X	X	X	X				
trip blank				2	X	X	X							

Relinquished by: (Signature) 1 [illegible signature]	Date/Time 5/6/91 1900	Received by: (Signature)	Relinquished by: (Signature) 4	Date/Time	Shipping Carrier: Federal Express
Relinquished by: (Signature) 2	Date/Time	Received by: (Signature)	Received for Laboratory by (Signature)	Date/Time	Shipping Ticket Number: 8452142214
Relinquished by: (Signature) 3	Date/Time	Received by: (Signature)	Chain of Custody Seal: (Circle) Intact Broken Absent	Lab Remarks	

APPENDIX C PRC FIELD NOTES

5/6/91 ≈ 7:30 Met with Becky Hyllard
John North

@ offices

Began with well level measurements at MW-D

@ 20

Well wizard pump 3013
w. Nitrogen canisters

MW-D
- some rust on casing
- plastic with discoloration
- short (too short)

Samples sent to:
Biogroup
12651 Indian Creek Ct
Beltsville Maryland
20705

purging commenced at 8:38
2" inner diameter well
- shut pump off
- pumped directly into plastic beaker. (rinsed out 12x)
BF:

8YC 5 gallon ~~[illegible]~~ bucket
- temp Taylor therm 21431
- Eh } DSPH3
- Ph }

request field sampling data
well construction report

shut pump off during measurements

2 gallons per well volume

Eh/Ph meter put on
wet, dirty, well pump top

water placed in 2 five gallon buckets - 7 gallons total

water placed in 55 gallon drum

9:06 started sampling
- VOAs
adjusted pressure during sampling
curried vial with headspace

BR.

- filled with meniscus
- not checked for bubbles

Alternately, filled 2
4 liter bottles
2x1 liter polyethylene

slide 16 pesticide samples

slide 15 VOA sampling

Duplicate sample site

90042 - D1 - 0591
Hong West 10
↓ month/year
D2
would be duplicate

10:00 MWG -
surveyed to top of casing
marked with pen

Ph/Eh calibrated at start of day
1°C increments

B.R.

total of 6 gallons purged
MW-6 Eh/Ph
decontaminated probe with
distilled H_2O between wells
4 well volumes purged

- Well locked 1035
- VOAs collected at too high a water volume

Order of sampling followed

11:50 MW-A
VOA vials tend to have bubbles
preservative purged from
containers.

19 VOA sampling
20 ~~sampling~~ MW-A (inside casing)
slide 21+22 sampling post @ MWA
23 VOA & Pesticide sampling
24 MW-F

new role of film
MW-F sampling

BF

1320 MW-E purging
slides 1-6 Soil Piles + MW-F

MW-E deep sampling
piezometer
no sand pack

slides 7-8 parameter sampling
MW-E
1637 well secured
wells marked with indelible
ink - ends not capped on MW-E

MW-A not marked
ends filled with grout
clear
MW-C 1636

pH	Eh	Temp	
8.51	008	17	Field blank
7.71	890	15°C	1
7.71	970	15°C	2
7.66	997	15°C	3

BF

1700 well secured
3 gallons purged
421

BF

YARL MON 05/06/91

0650 PRC arrived on site

0720 Becky Hylland, SE* arrived

Weather overcast 50°F

SE will first take water level measurements in all wells using a Slope Indicator Co. electronic water sensor. The WL indicator was first rinsed with 1:1 HRDC methanol : distilled water then with distilled water (Culligan Spring) while on the reel just before the measurement is taken.

MW-D 34.73 ft

MW-G 37.68

Water level is measured to a mark on the outer casing

All stick up wells were locked with a Master Padlock

SE = Sweet Edwards

WATER LEVELS
DTW
MW-D 34.73'
MW-G 37.68'
MW-B 37.18'
MW-A 36.97'
MW-F 36.75'
MW-E 35.74'
MW-C 36.55'

The WL indicator tape is pulled to the side to an arrow on the outer casing

The well with ~~road box~~ flush mount MW-D was secured with 2 locking hex bolts requiring a hollow allen wrench to open them

Finished WL measurements at 0815

Wells will be purged with dedicated well wizard pumps (bladder pumps)
Nitrogen is used as the compressed gas source

~~SE~~ samples will be sent to Biospherics in Maryland.
12051 Indian Creek Court
Beltsville, MD 20705

MW-D 01

0838 began purging

Total depth - 46'
DTW 34.73'
WC 11.27'
Diameter = 2"

SE ~~test~~ will purge 6 gals.
purge water clear + colorless
no discernable odor at 2'

	①		②	③
time	0846		0852	0858
gals ppl	2		4	7
pH	6.32	7.03	7.35	7.33
cond	963		923	919
temp	14°		14°	14°

0900 finished purging
0905 began sampling
0930 finished sampling

MW-D

SW #s 90042 - ~~01~~ 0591-01
90042 - ~~02~~ 0591-02(dup)

Problems sampling due to the shortened length of the tubing from this well - made it very awkward for the sampler to do field measures she had to keep stopping the purging process to do measurements.

She said that normally the tubing is longer + someone had cut it.

2nd. carry extra tubing

She also lost a septa from a VOA vial & therefore could not complete the sample set

2nd: carry extra bottles.

MW-G

0954 began purging MW-G

Total D	50'
DTW	37.68'
WC	12.32'
diameter	2"

SW will purge 6 gals (unless 2 in field parameters do not stabilize)
clean coolers, 20 add'l oz

	①	②	③	④
time	1000	1007	1011	1016
purged	2 gal	4	6	8
pH	8.16	7.94	7.83	7.88
cond	579	598	686	701
T	14.5	14.5	14.5	14.5

1018 finished purging
began sampling
1035 finished sampling

SW # 90043 0591 G1

Problems

flow rate was really too fast for collecting VOC samples

lost another VOA vial Septa - rinsed w/ purge water & used it

Recalibration of instruments

cond. meter
set zero
set span cond STD 720 µMHO

pH set cal to 7.0 STD
set slope to 4.0 STD

MW-B

	①	②	③
time	1048	1051	1056
purged	2	3	4.5
pH	7.56	7.71	7.66
cond	815	934	961
T	15	14	14

Total D	47'
DTW	37.18
WC	9.82
diameter	2"

SW will purge 4.5 gals for 3 cas Vs
clear, colorless, no odor
finished sampling 1602

SC Sample # 90042-0591-B1

PRC will not collect split sample from MW-B

The flow rate was better for VOC sample collection.

All purge water is collected in 55-gal drums which are then pumped out

very light fine rain for ½ hr

MW-A

began purging 11:21

TD	42'
DTW	36.97'
WC	5.03'
dia	2"

SE will purge 3 gals for 3 WC volumes
clear, colorless, no odor

purged	1	2	3
pH	6.33	7.15	7.32
cond	1106	1017	1034
T(°)	15	15	15

Started sampling 11:45
finished 12:35
TOOK extra volume for MS/MSD
and also took duplicate (MW-K) at this well
sampling time 12:15

MW-A (cont)

SE # 90042-0591-A1

pump rate was fast for VOAs

now sunny 70°

MW-F

began purging 1235

	①		
purged	2	4	6
pH	7.82	7.71	7.60
cond	1030	1038	1046
T	15	15	15

finished purging 1252
began sampling 1254
finished sampling 1313

SE Sample #
90042-0591-F1

Sampling stream was very aerated !!

MW-E

Changed Nitrogen bottles

began purging 1320

finished 1610

began sampling 1613

finished

① ② ③

Time purged	1616	1632	1648
pH	7.46	7.47	7.39
Cond	699	738	733
T	15	15	15°C

1340 at 17 gals purged no field measurements have been taken because Becky is calling H because she is running out of space in the purge water collection drums

TD 125'

DTW 35.74'

WC 92.26'

dia 2"

We will stop until we can get a drum 1400

began purging again 1502

Transfer Blank 1655

Location: South of MWs E, F

APPENDIX D OPERATION AND MAINTENANCE FIELD INSPECTION CHECKLIST

4. Observe the owner/operator's staff as they collect ground-water samples at several wells. Complete the following table for each well (Note: revise or add to the table if permit conditions dictate a different requirement the owner/operator must follow):

Position/Title	Name	Sampling Experience (years and type)
Geologist	Becky Hylland	2 1/2 yr. of environmental

Well Identification Number MW-D (Also applies to most other wells)	Y/N	Photograph Taken Y/N
Did the sampling crew measure static water levels in the well and well depths prior to the sampling event?	N	N
Did the sampling crew use a steel tape or electronic device totake depth measurements?	Y	Y
Did the sampling crew record depths to +/– 0.01 feet?	Y	Y
Did the sampling crew follow these procedures: 1. remove locking and protective cap; 2. sample the air in the well head for organic vapors; 3. determine the static water level; and 4. lower an interface probe into the well to detect immiscible layers.	N	N
If immiscible samples were collected, were they collected prior to well purging?	NA	—
Did the sampling crew evacuate low yielding wells to dryness prior to sampling?	N	—
Did sampling crew evacuate high yielding wells so that at least three casing volumes were removed?	Y	Y
Did the sampling crew collect the purge water for storage and analysis or for shipment off-site to a RCRA treatment facility?	N	N
Were sampling devices constructed of fluorocarbon resins or stainless steel?	NA	—

(Continued)

Well Identification Number MW-D	Y/N	Photograph Taken Y/N
If the sampling crew used dedicated samplers, did they disassemble and thoroughly clean the devices between samples?	NA	—
If samples are collected for organic analyses, did the cleaning procedure include the following steps: 1. non phosphate detergent wash 2. tap water rinse 3. distilled/deionized water rinse 4. acetone rinse 5. pesticide-grade hexane rinse? methanol followed by distilled H_2O	N	Y
If samples are collected for inorganic analyses, does the cleaning procedure include the following steps: 1. dilute acid rinse (HNO_3 or HCL) 2. distilled/de-ionized water rinse?	N	N
Did the sampling crew take trip blanks, field blanks and equipment blanks? Yes Yes No	Y	N
If the sampling crew used bailers, were they bottom valve bailers?	NA	—
If the sampling crew used bailers, was "teflon" coated wire, single strand stainless steel wire or monofilament used to raise and lower the bailer?	NA	—
If the sampling crew used bailers, did they lower the bailer slowly to the well?	NA	—
If the sampling crew used bailers, were the bailer contents transferred to the sample container to minimize agitation and aeration?	NA	—
Did the sampling crew take care to avoid placing clean sampling equipment, hoses, and lines on the ground or other contaminated surfaces prior to insertion in the well?	Y	N
If the sampling crew used dedicated bladder pumps: Was the compressed gas from an oilless compressor certified quality commercial compressed gas cylinder? If not, was a suitable oil removal purification system installed and maintained?	Y	N
Was the bladder pump controller capable of throttling the bladder pump discharge flow to 100 ml/min or less for continuous periods of at least 20-30 seconds without restricting liquid discharge?	not known	N

VOAs collected with too high a flow rate

Well Identification Number MW-1	Y/N	Photograph Taken Y/N
Were samples taken from the bladder pump discharge tube, and not from any purge device discharge tube? ~~For~~	Y	Y
Was the bladder pump discharge flow checked for the presence of gas bubbles before each sample collection, as a test for bladder integrity?	N	N
Was bladder pump flow performance monitored regularly for dropoff in flow rate and discharge volume per cycle?	Y	N
Was the bladder pump incorporated in a combination sample-purge pump design which can expose the bladder pump interior and discharge tubing to the pump drive gs? If so, were operating procedures established and followed to prevent at all times the entry of drive gas into the sample flow or into the bladder pump interior?	N	N
Did the sampling crew collect and containerize samples in the order of the volatilization sensitivity of the parameters?	Y	Y
Did the sampling crew measure the following parameters in the field: pH, temperature, specific conductane?	Y	Y
Did the sampling crew sample background wells before sampling downgradient wells?	Y	Y
Did the sampling crew use fluorocarbon resin or polyethylene containers with polypropylene caps for samples requiring metals analysis?	Y	Y
Did the sampling crew use glass bottles with fluorocarbon resin-lined caps for samples requiring metals analysis?	N	N
If metals were the analytes of concern, did the sampling crew use containers cleaned with nonphosphate detergent and water, and rinsed with nitric acid, tap water, hydrochloric acid, tap water and finally Type II water? Cleaned at lab	unknown	—
If organics were the analytes of concern, did the sampling crew use (cleaned at lab) containers cleaned with nonphosphate detergent, rinsed with tap water, distilled water, acetone, and finally pesticide quaility hexane?	unknow	—
Did the sampling crew filter samples requiring analysis for organics?	NO	—

2. Visually inspect each well and piezometer and complete the table below (one line entry for each well or piezometer):

minor rust on casing of all wells

Well/ Piezometer	Survey Mark Present?	Standing or Ponded Water?	Evidence of Collision Damage?	Evidence of Frost Heaving?	Evidence of Casing Degradation?	Lock in Place?	Evidence of Well Subsidence?	Photograph Taken?
MW-D	Yes	Standing water small wells.	No	No	minor rust No	flush mount-bolted	No	Yes
MW-G	Yes	No standing water outside of casing	No	No	No	Yes	No	Yes
MW-B	Yes		No	No	No	Yes	No	Yes
MW-A	Yes		No	No	No	Yes	No	Yes
MW-F	Yes		No	No	No	Yes	No	Yes
MW-E	Yes		No	No	No	Yes	No	Yes
MW-C	Yes		No	No	No	Yes	No	Yes

APPENDIX E YARL ANALYTICAL DATA SUMMARY

BIOSPHERICS INCORPORATED

CLIENT: Hong West

DATE COLLECTED: May 6, 1991

DATE RECEIVED: May 9, 1991

MATRIX: Water

LAB I.D.: 91-05-0916

Analytical Methodology/Sample Chronicle

Parameter	Method	Date Extracted	Date Analyzed
Metals	EPA 6010/7000's	5/15/91	5/14-29/91
Mercury	EPA 7470	5/21/91	5/21/91
Pesticides/PCB's	EPA 8080	5/10/91	5/13-14/91
Organophosphorus Pesticides	EPA 8140	5/13/91	5/16/91
Volatile Organics	EPA 8240		5/18/91
Herbicides	EPA 8150	5/13/91	5/15/91

Non-conformance Summary

Pesticides/ PCB's

Endrin yielded low recoveries (<56%) in the spike blank, matrix spike, and matrix spike duplicate. Surrogate recoveries were acceptable in all samples. Since holding time expired, samples were not reextracted. Lindane recoveries in the matrix spike and matrix spike duplicate were below acceptable levels (<56%). However, the spike blank was acceptable and the data was released with confidence.

Organophosphorus Pesticides

Due to a spiking error TEPP recovery was low (<40%) in all quality control samples. The TEPP analyses cannot be reported with confidence.

SUMMARY OF MAY 6, 1991 MONITORING
YAKIMA AGRICULTURAL RESEARCH LABORATORY

Split Sample Collection: Split samples taken from MW-G, MW-D, MW-A, MW-F and MW-E.

Summary of Results (units are ug/L) ND - denotes non-detected or below quantitation limit

WELL ID	volatile org. 8240	TCL Metals	Pest/PCB 8080	Insect/Herb 8140/8150
MW-G	ND	Ca 74,200 Mg 46,600 K 3,540 Na 64,300 V 75.8	ND	ND
MW-D	ND	Ba 57.3 Ca 73,500 Mg 45,700 K 3,210 Na 68,000 V 74.9 Zn 27.0	ND	ND
MW-A	ND	Ca 76,000 Pb 3.5 Mg 43,200 K 4,030 Na 62,500 V 57.2 Zn 20.3	ND	ND
MW-F	ND	Ca 78,200 Mg 45,400 K 3,610 Na 61,800 V 71.9 Zn 39.7	ND	ND
MW-E	ND	Ca 59,300 Mg 28,600 K 4,820 Na 30,100	ND	ND

APPENDIX F PRC ANALYTICAL DATA SUMMARY

TABLE 1

INORGANIC ANALYTICAL RESULTS, YAKIMA AGRICULTURE RESEARCH LABORATORY ($\mu g/L$)

Sample Location:	MW-D		MW-A		MW-A		MW-E		MW-F		MW-G	
	T	D	T	D	T	D	T	D	T	D	T	D
Contract Laboratory Program Number:	MJF123	MJF124	MJF144	MJF145	MJF146	MJR147	MJF413	MJF414	MJF148	MJF149	MJF125	MJF143
Aluminum	14.0U	14.0U	14.0U	14.0U	28.8	15.1	14.0U	14.0U	17.2	31.4	14.0U	19.5
Arsenic	7.2	7.2	5.2	5.6	4.7	4.9	3.0	2.8	5.4	6.1	6.3	6.9
Barium	21.6	21.1	20.5	25.2	20.0	20.6	24.2	24.6	18.0	17.7	18.3	18.2
Calcium	71,400.0	74,500.0	79,800.0	78,500.0	79,100.0	78,600.0	57,900.0	55,100.0	74,[illegible]00.0	76,400.0	75,700.0	71,400.0
Copper	4.3	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U
Iron	34.1	8.0U	12.1	8.0U	20.1	13.2	10.4	8.0U	11.5	8.0U	8.0U	8.0U
Lead	5.5	2.7	2.7	3.4	17.2	3.0	1.0U	3.0	2.9	4.1	3.0	3.9
Magnesium	44,300.0	45,600.0	44,000.0	43,600.0	43,100.0	42,500.0	27,200.0	26,800.0	43,[illegible]00.0	44,600.0	46,700.0	44,900.0
Potassium	3,290.0	3,320.0	4,190.0	4,190.0	4,070.0	4,020.0	4,790.0	4,800.0	3,[illegible]10.0	3,550.0	3,550.0	3,570.0
Sodium	67,200.0	68,600.0	65,800.0	65,400.0	63,100.0	62,000.0	30,100.0	30,500.0	59,[illegible]00.0	61,700.0	67,300.0	65,600.0
Vanadium	66.6	68.0	52.2	52.2	50.8	54.4	26.5	27.1	59.1	60.5	67.7	65.0
Zinc	11.3	8.7	7.0U	7.0U	7.0U	21.7	7.0U	7.0U	9.1	7.0U	7.0U	7.0U

Notes:

Metals not listed were not found in any samples.
T = Total metals.
D = Dissolved metals (sample filtered in the field).
Qualifier: U = Not detected; listed value is the sample detection limit.

TABLE 2

ORGANIC ANALYTICAL RESULTS,
YAKIMA AGRICULTURE RESEARCH LABORATORY
(µg/L)

Sample Location:	Trip Blank	MW-D	MW-A	MW-A	MW-E	MW-F	MW-G
Contract Laboratory Program Number:	JG889	JG879	JG885	JG886	JG888	JG887	JG884
Volatile Organics							
Methylene chloride	2J	5U	5U	5U	5U	5U	5U
Acetone	10U	10U	10U	10U	4J	5J	10U
Chloroform	5U	5U	2J	1J	1J	2J	3J
Tetrachloroethene	5U	3J	5U	5U	5U	1J	5U
Pesticides and PCBs							
Endosulfan sulfate	NS	0.10U	0.20	0.17	0.10	0.10	0.10

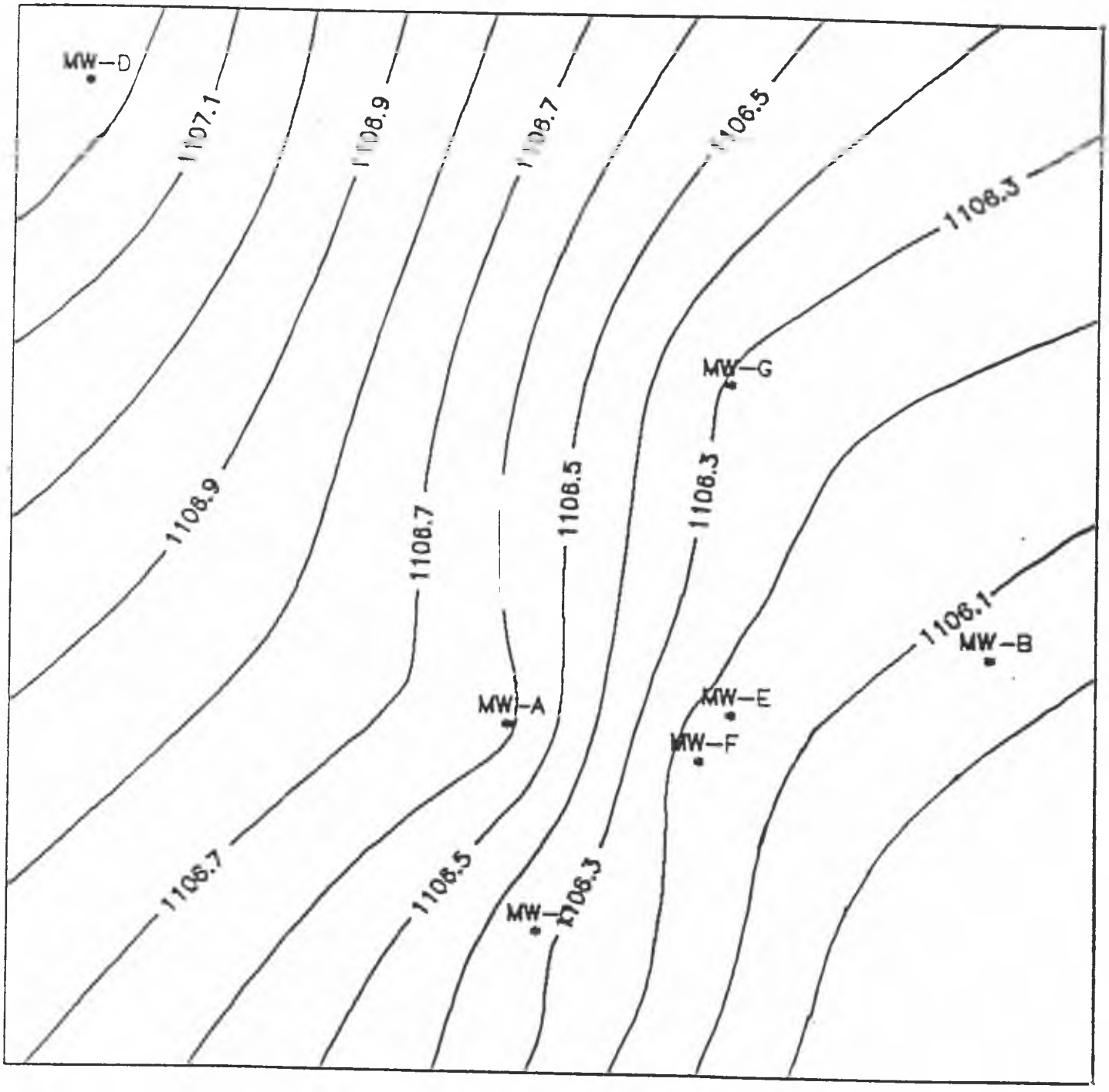
Notes:

Chemicals not listed were not found in any samples (including all target analytes in the organophosphorus pesticide and chlorinated herbicide assays).

Qualifiers: U = Not detected; listed value is the contract-required quantitation limit (CRQL).
J = Estimated value; most commonly the chemical was found at a concentration less than the CRQL.
NS = No sample.

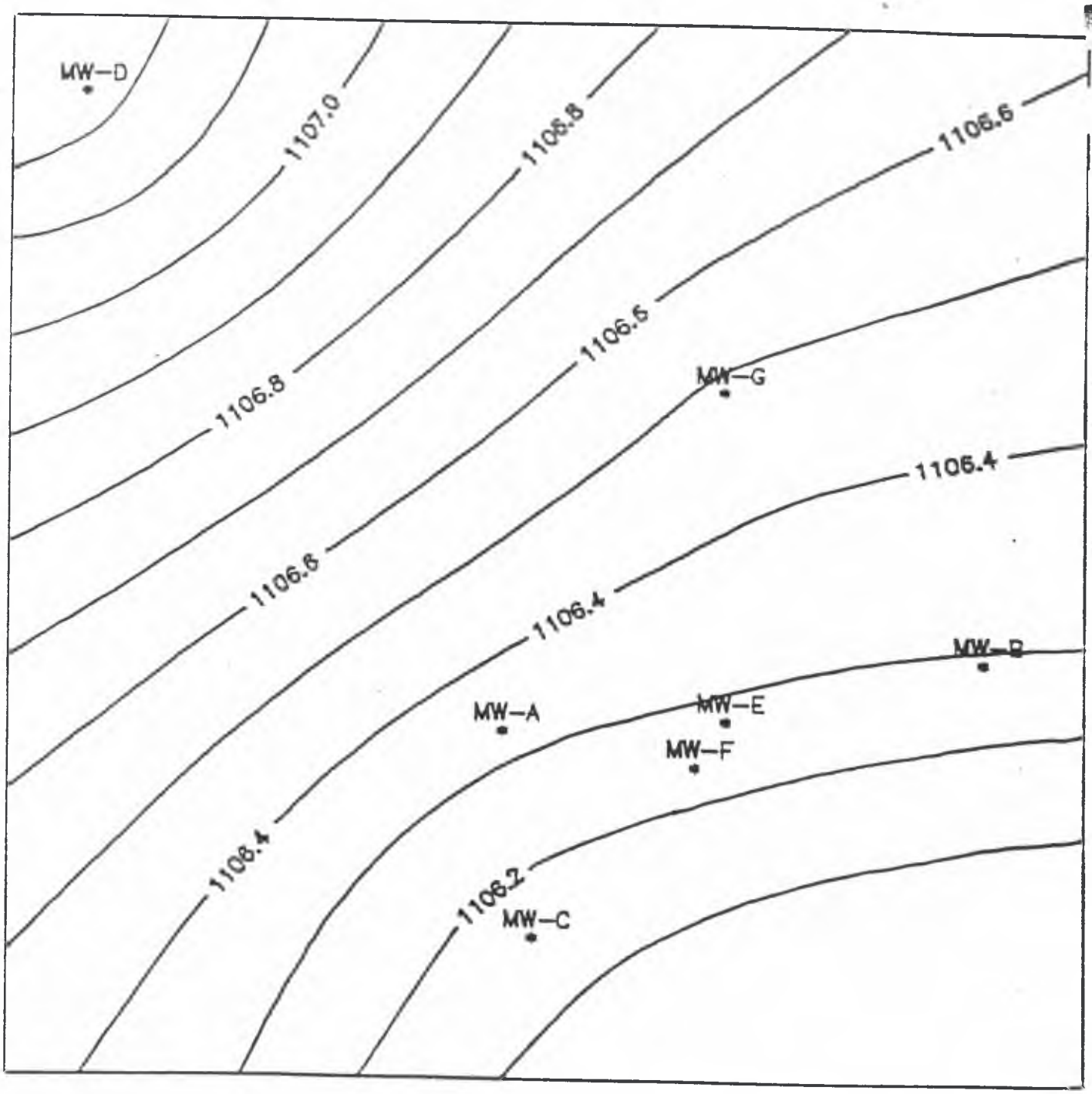
APPENDIX G POTENTIOMETRIC SURFACE MAPS FOR THE YARL SITE

YARL GROUNDWATER LEVEL 8-7-90

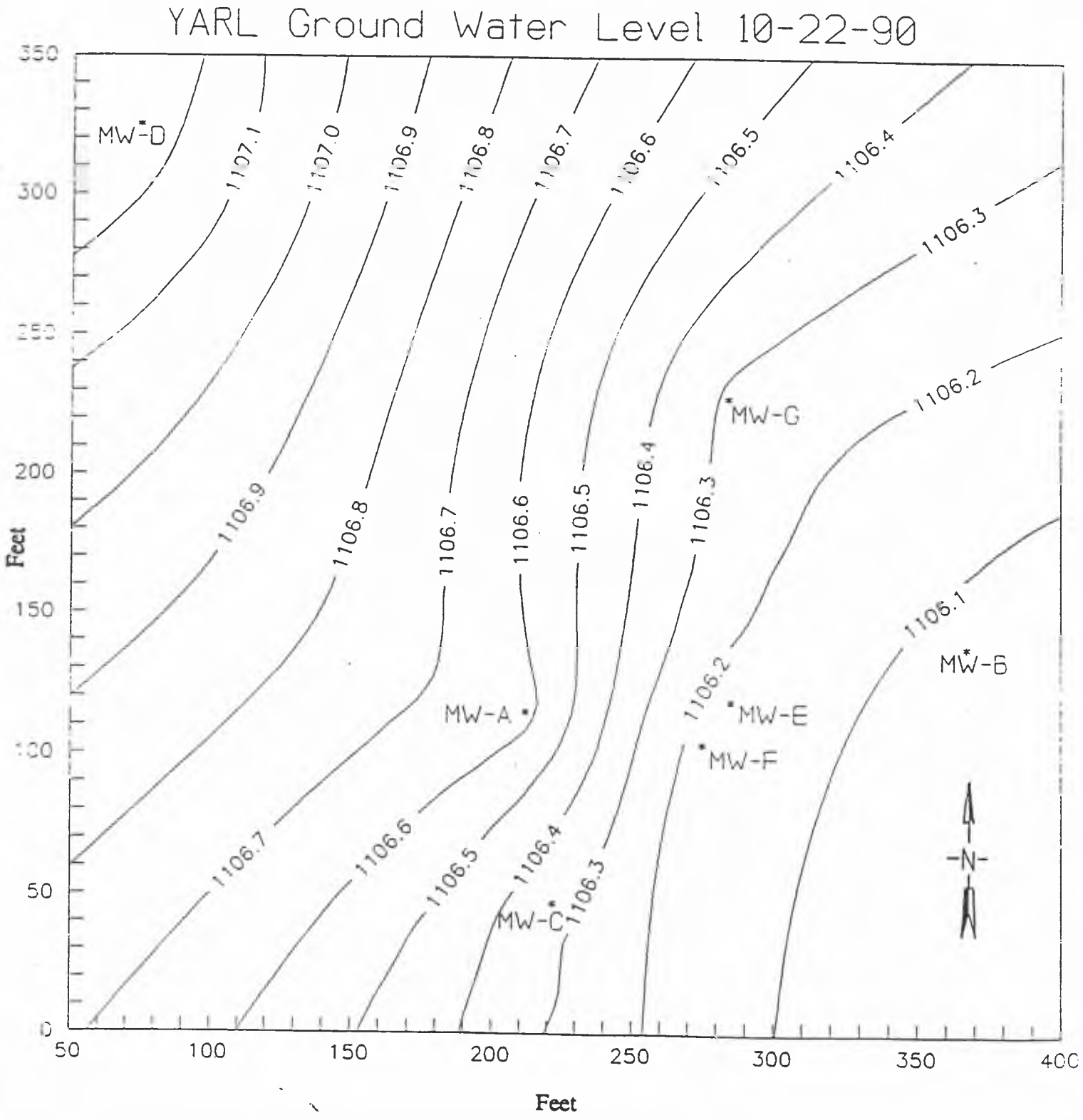


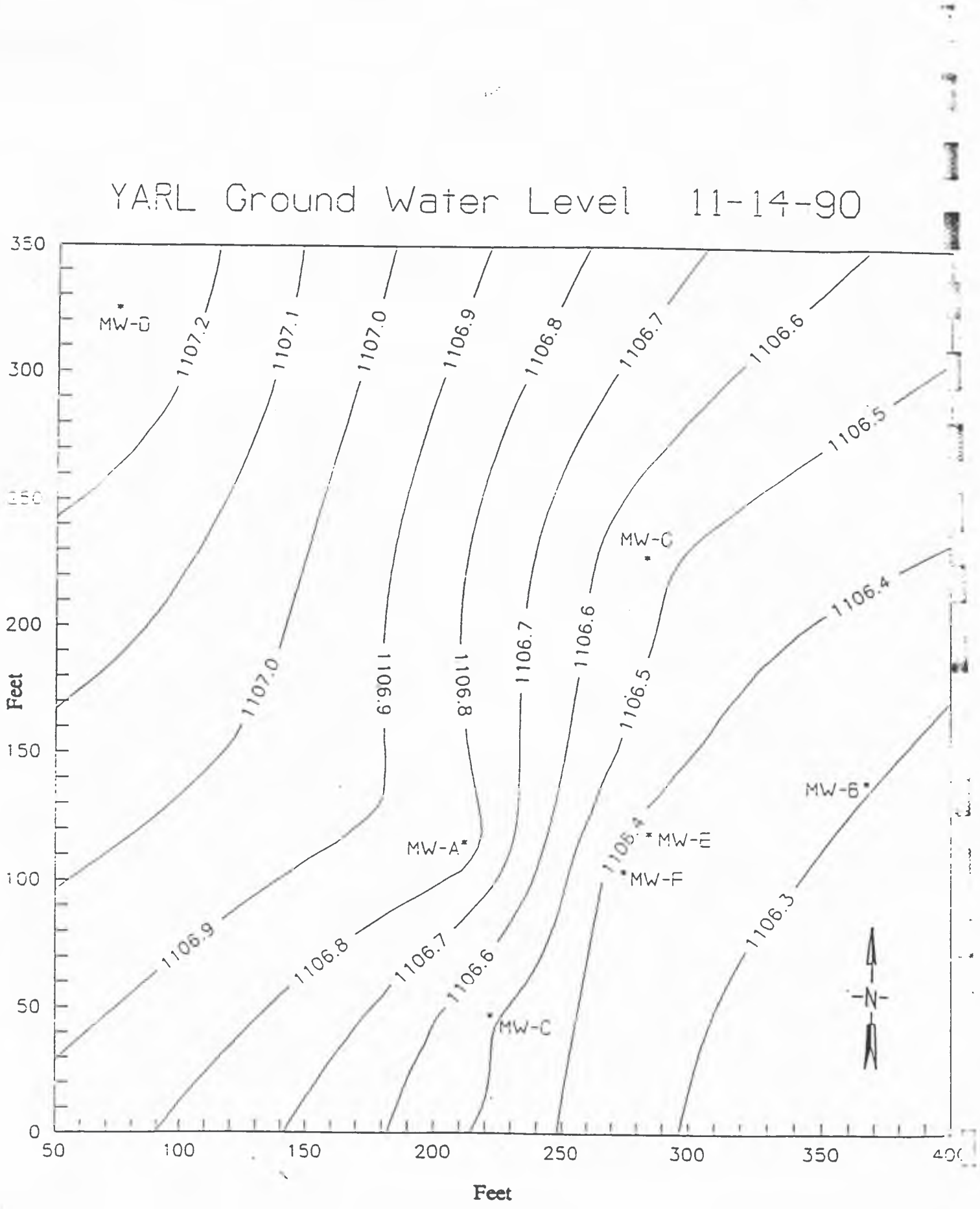
SCALE 1 inch = 50 FEET

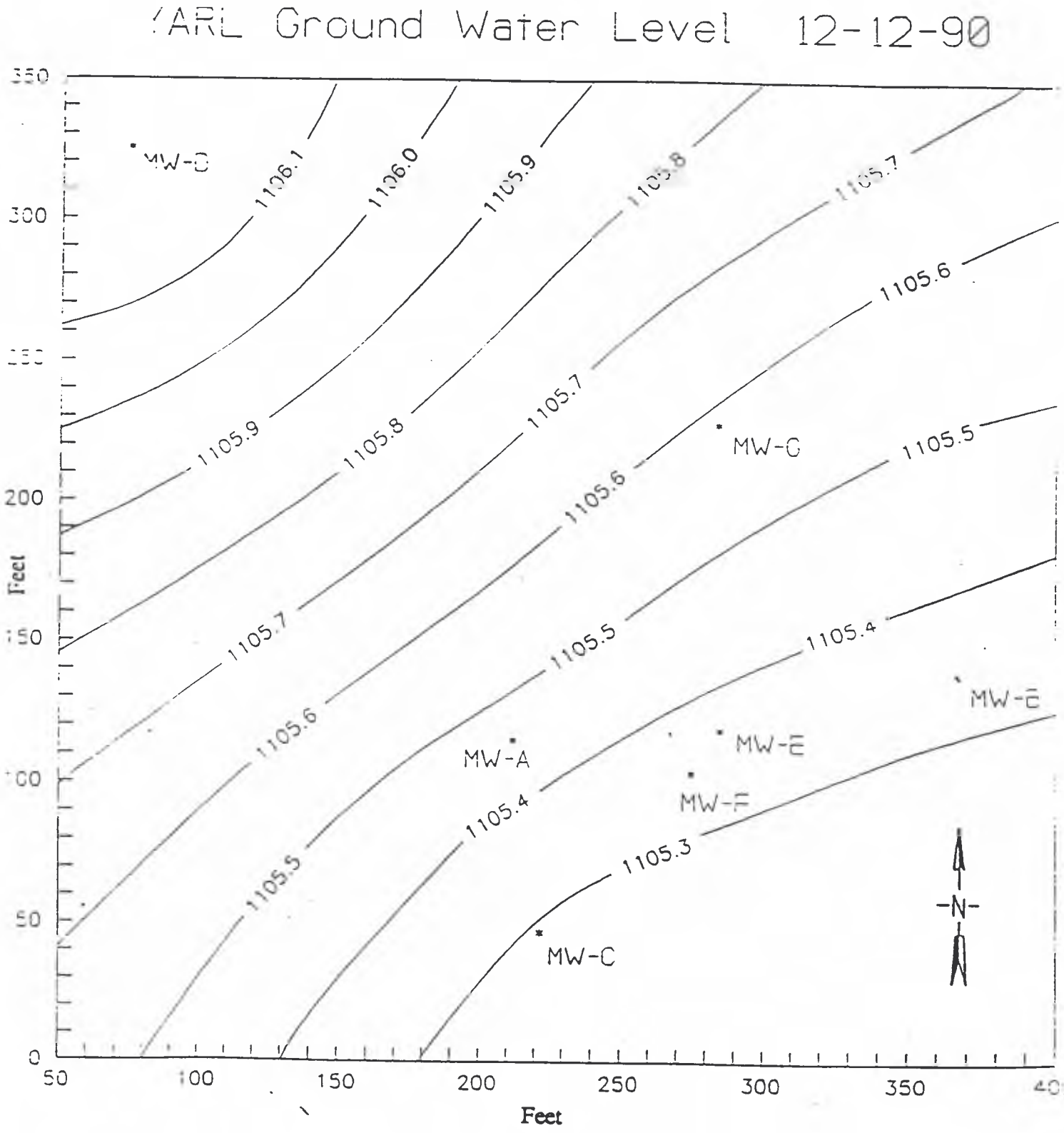
YARL GROUNDWATER LEVEL 9-4-90



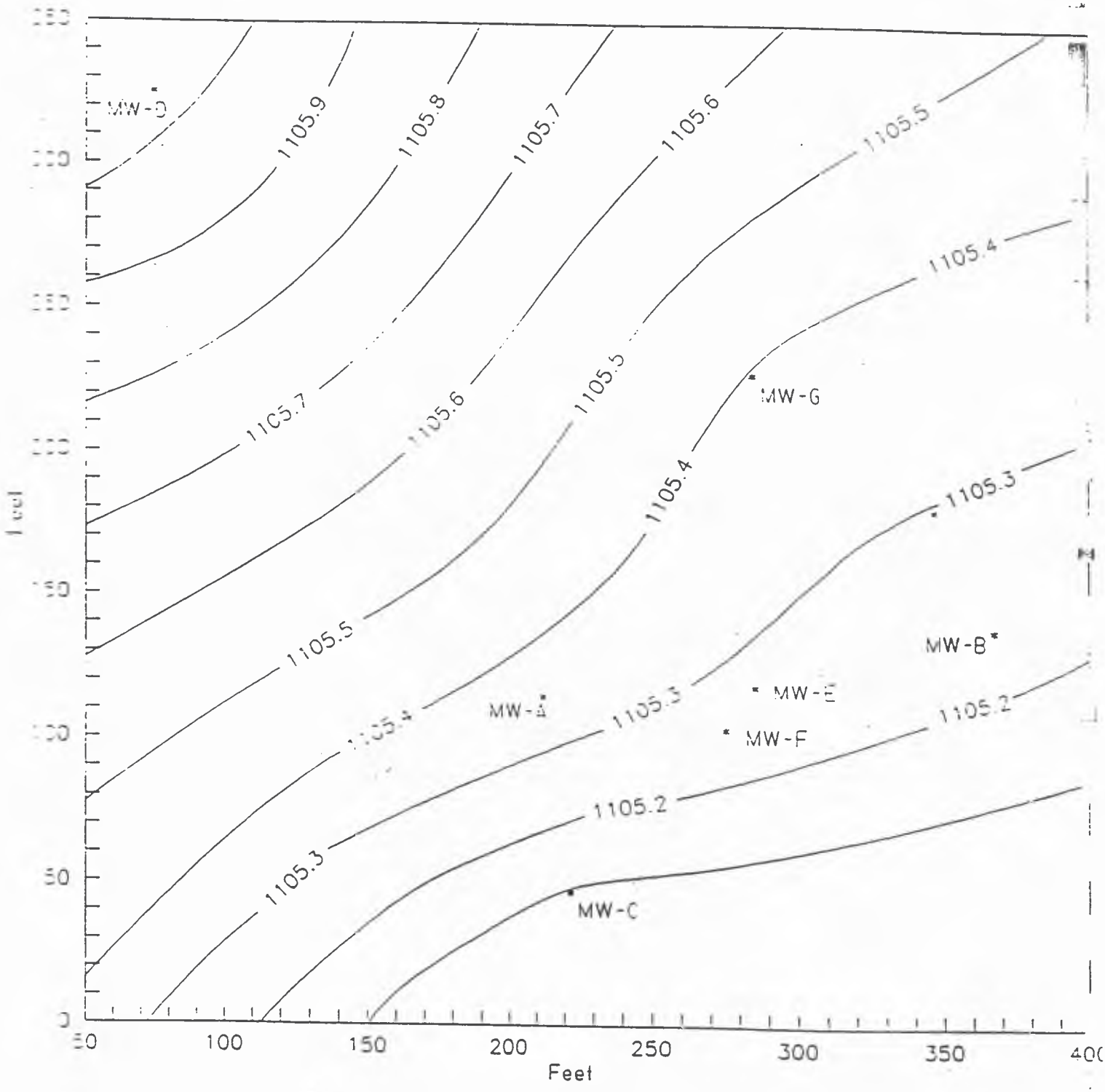
SCALE 1 inch = 50 FEET

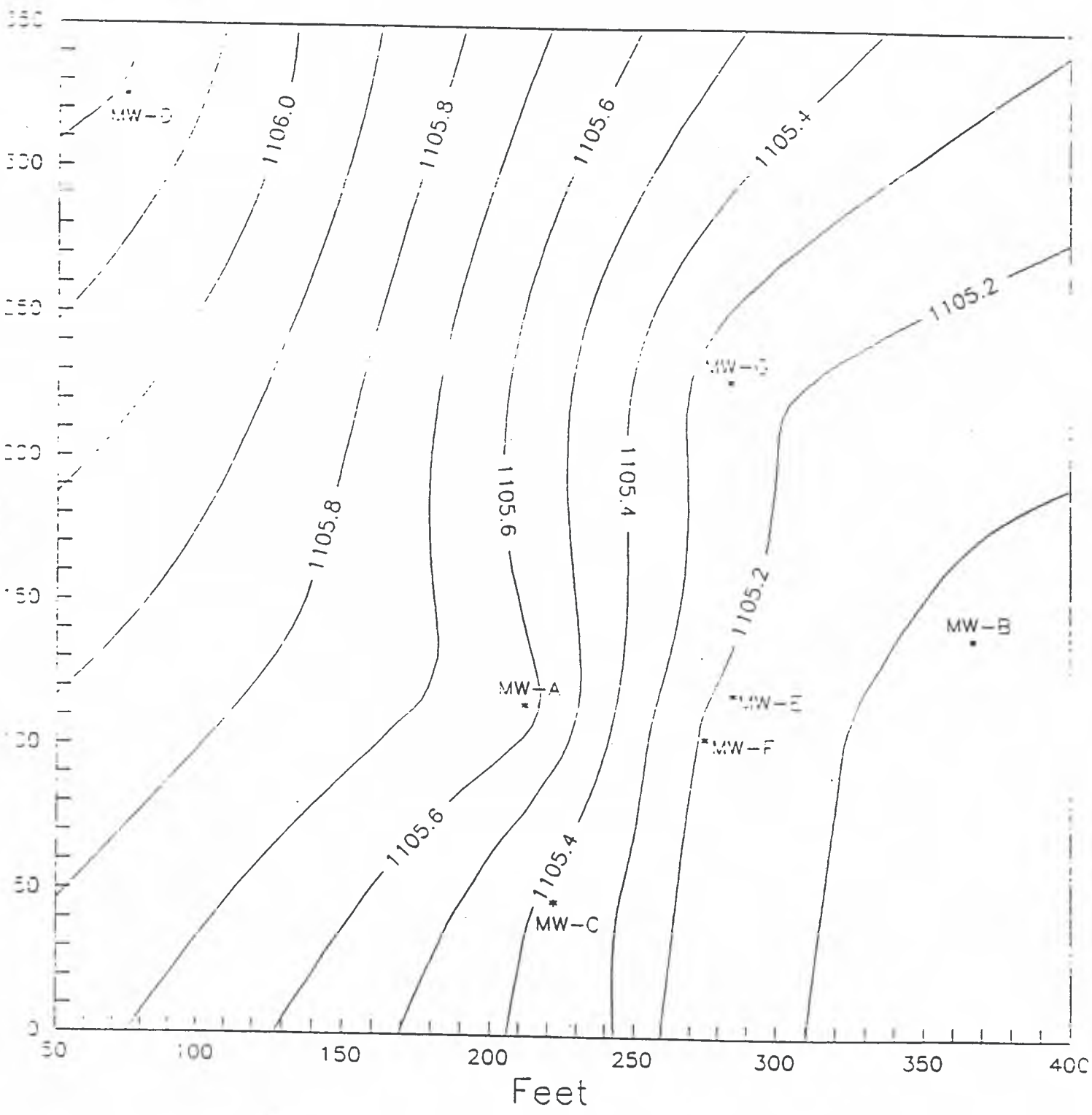

YARL Ground Water Level 10-22-90
MW-D
MW-A
MW-C
MW-E
MW-F
MW-G
MW-6
1107.1
1107.0
1106.9
1106.8
1106.7
1106.6
1106.5
1106.4
1106.3
1106.2
1106.1
-N-
Feet
Feet
0
50
100
150
200
250
300
350
400

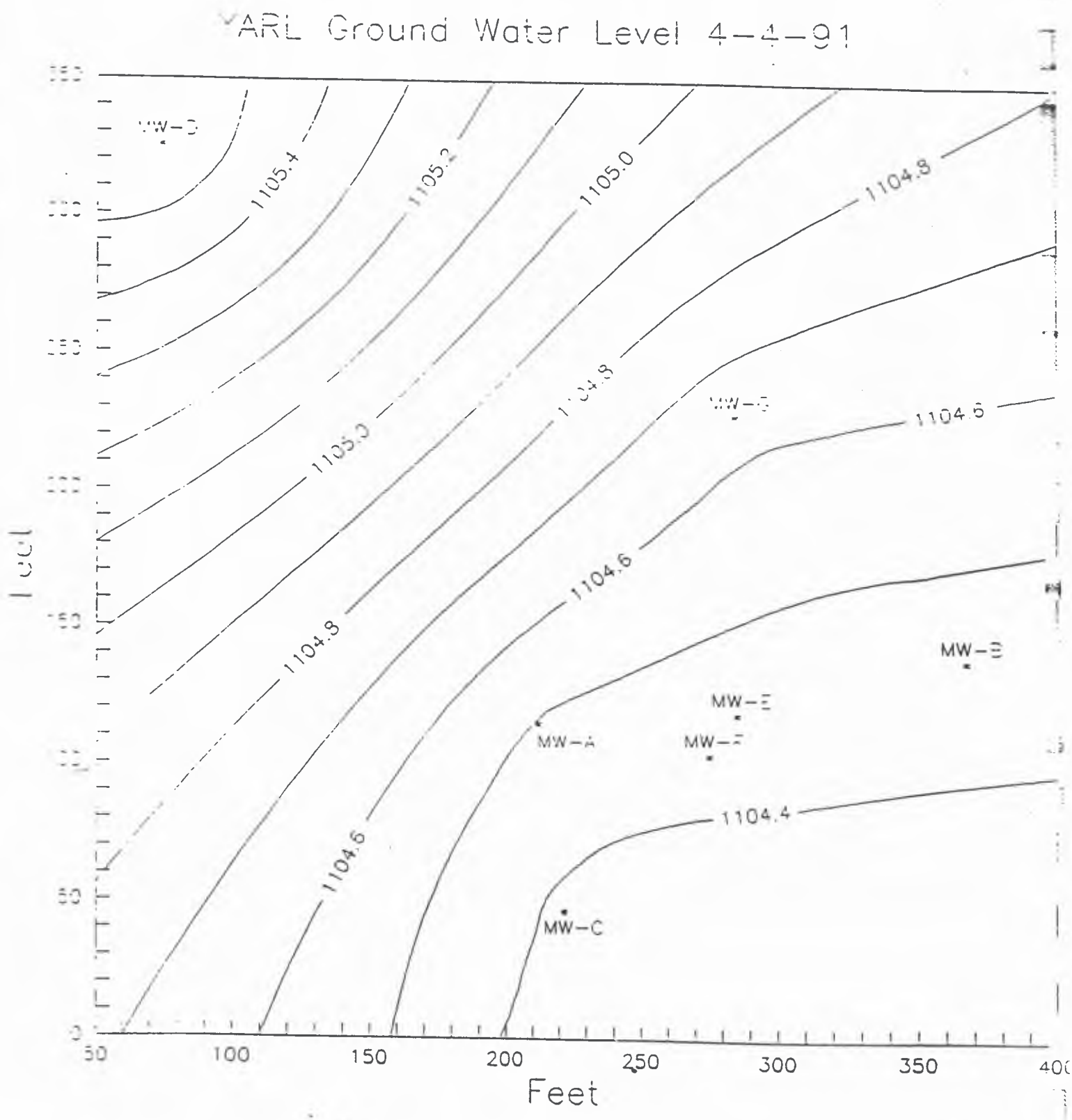

YARL Ground Water Level 11-14-90
MW-D
MW-A
MW-B
MW-C
MW-C
MW-E
MW-F
1107.2
1107.1
1107.0
1106.9
1106.8
1106.7
1106.6
1106.5
1106.4
1106.3
1107.0
1106.9
1106.8
1106.7
1106.6
1106.5
1106.4
1106.3
350
300
250
200
150
100
50
0
Feet
50
100
150
200
250
300
350
Feet
-N-


YARL Ground Water Level 12-12-90
MW-D
MW-C
MW-A
MW-E
MW-E
MW-F
MW-C
1106.1
1106.0
1105.9
1105.8
1105.7
1105.6
1105.5
1105.4
1105.3
1105.9
1105.8
1105.7
1105.6
1105.5
1105.7
1105.6
1105.5
1105.4
-N-
Feet
Feet
0
50
100
150
200
250
300
350
400

ARL Ground Water Level 1-3-91




ARL Ground Water Level 3-13-91
MW-D
1106.0
1105.8
1105.6
1105.4
1105.2
MW-G
MW-B
MW-A
MW-E
MW-F
MW-C
1105.8
1105.6
1105.4
1105.2
1105.6
1105.4
Feet
50
100
150
200
250
300
350
400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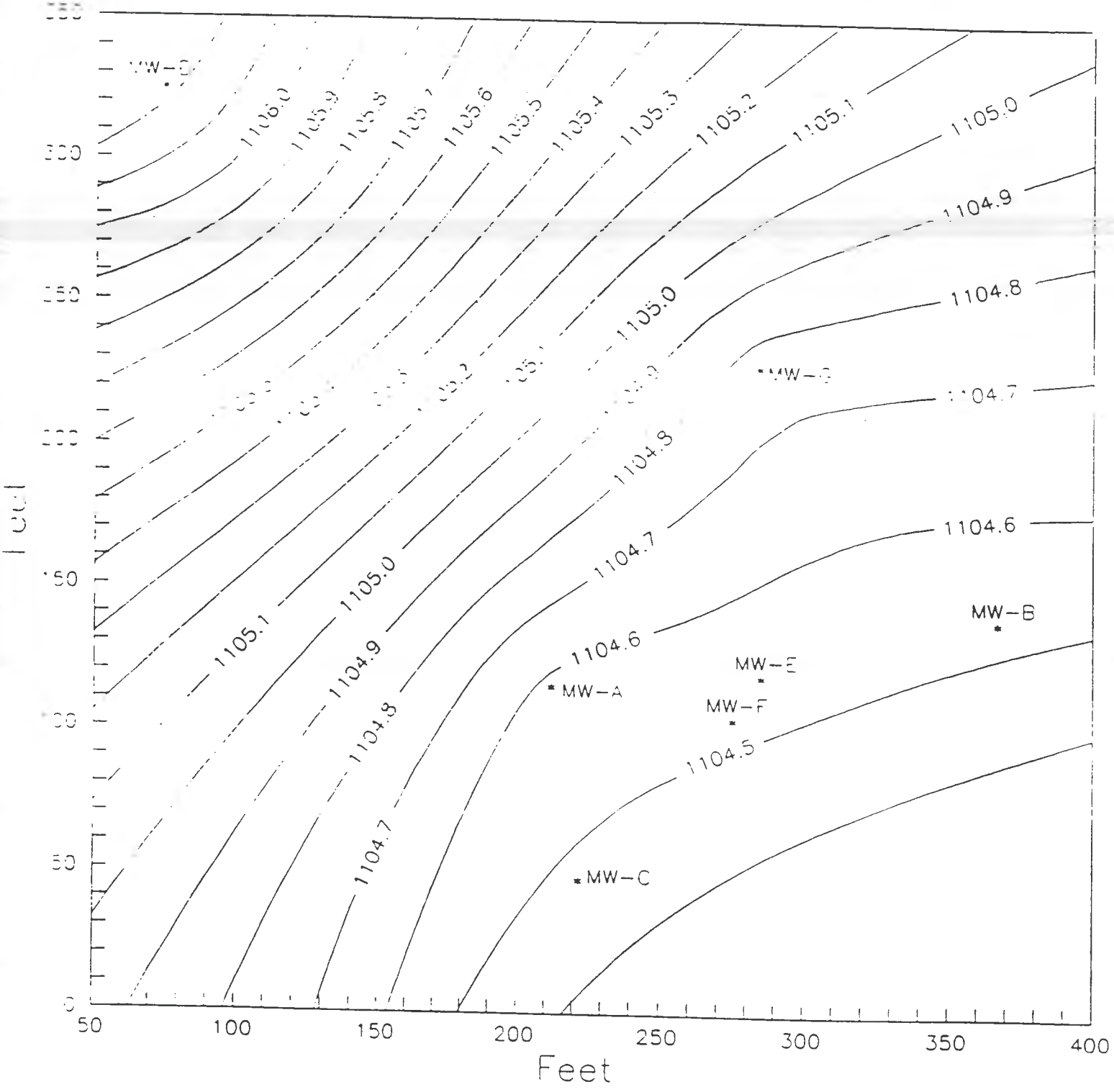
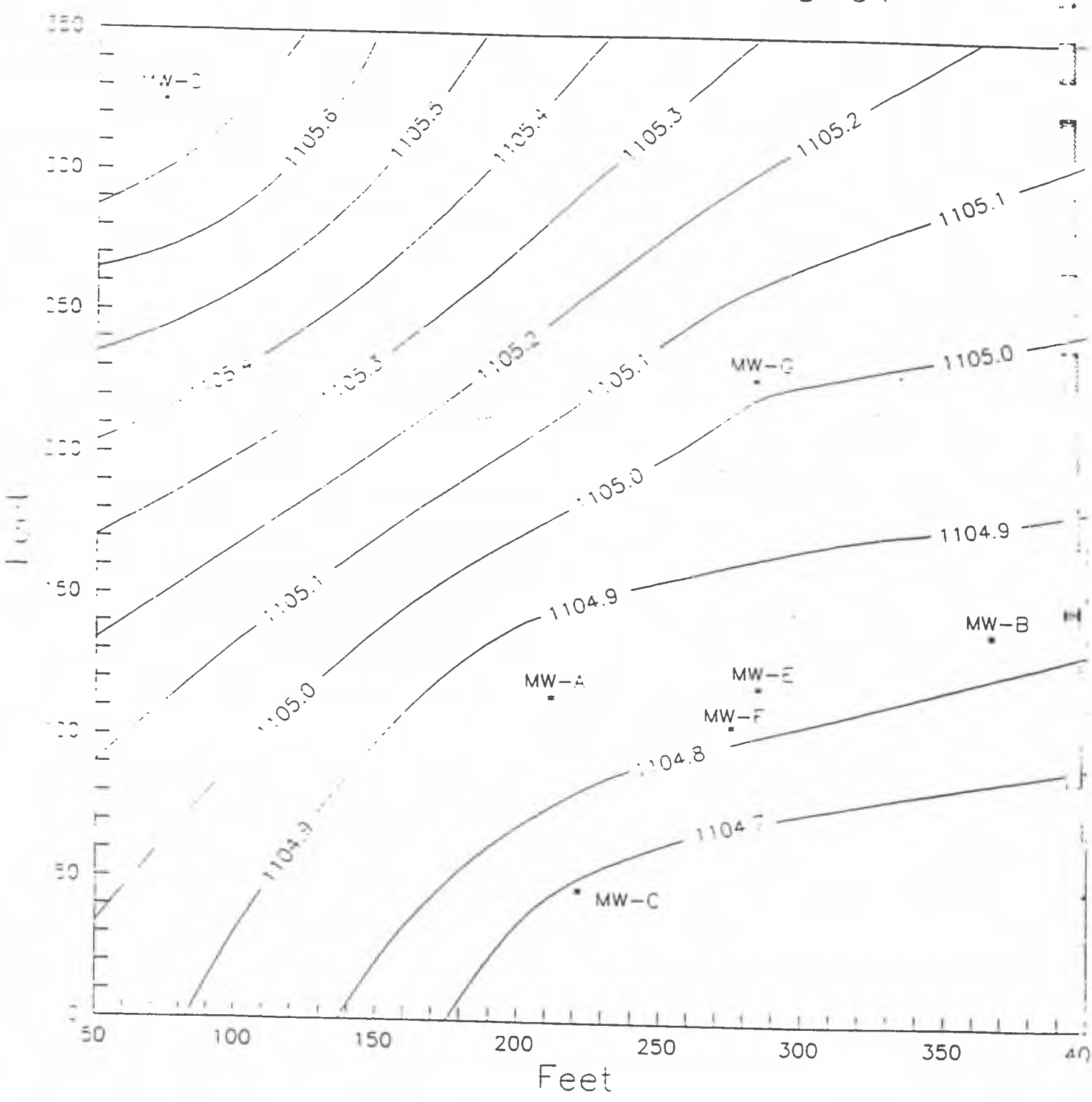
MW-D
1105.4
1105.2
1105.0
1104.8
1105.0
1104.8
MW-B
1104.6
1104.6
1104.8
MW-E
MW-E
MW-A
MW-F
1104.4
1104.6
MW-C
Level
50
100
150
200
250
300
350
Feet

YARL Ground Water Level 5-6-91




ARL Ground Water Level 6-13-91
MW-D
MW-G
MW-B
MW-A
MW-E
MW-F
MW-C
1105.6
1105.5
1105.4
1105.3
1105.2
1105.1
1105.0
1104.9
1104.8
50
100
150
200
250
300
350
Feet

ARL Ground Water Level 7-16-91